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The Watts-Campbell Company's Corliss Engine.

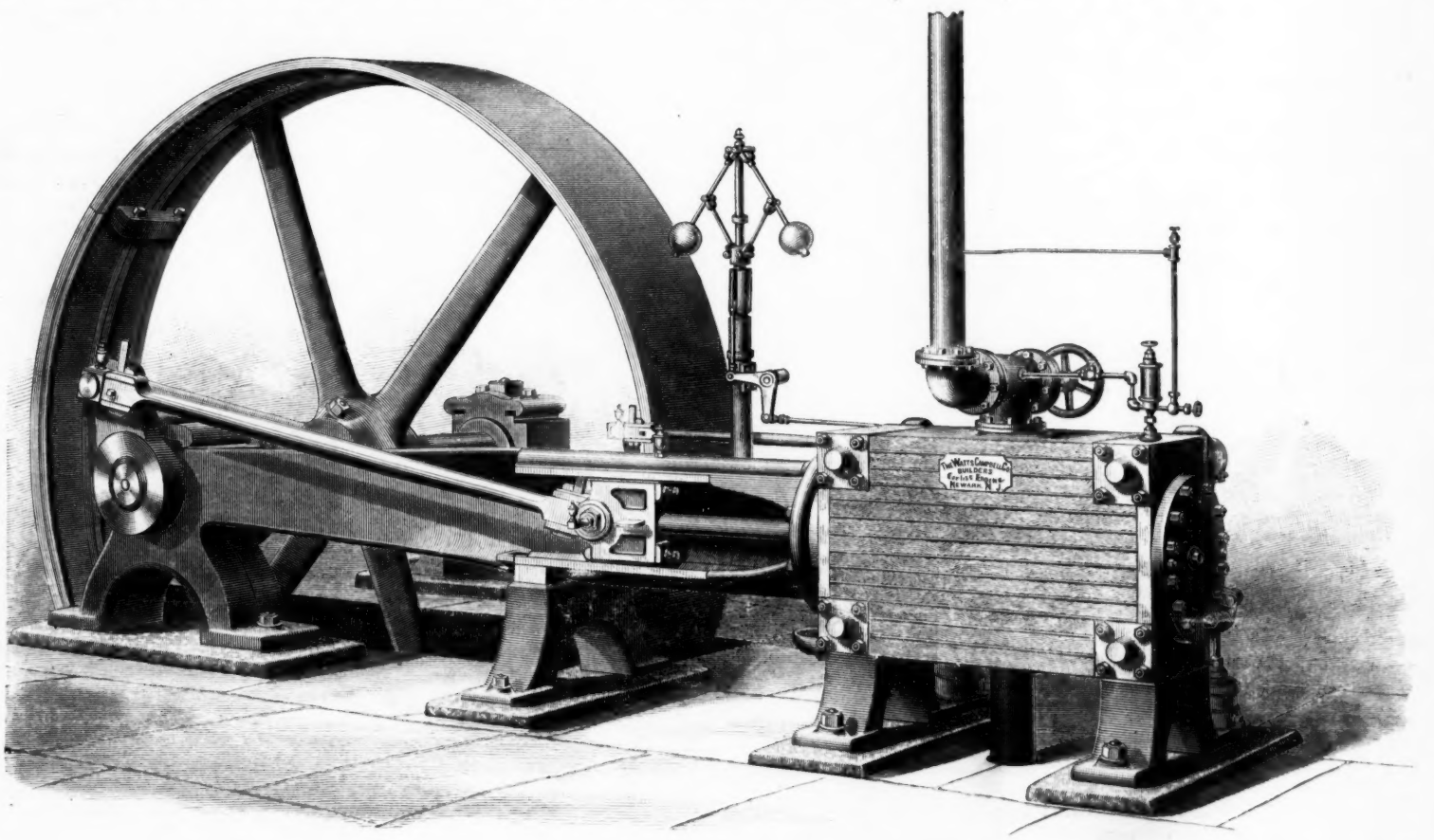
The engravings on this page represent this engine in two views, and those on pages 2 and 3 some of the details. Important changes in the details of this engine have been made, some of which are shown by the engravings. Referring to the detail cuts, Fig. 1 shows the new releasing gear.

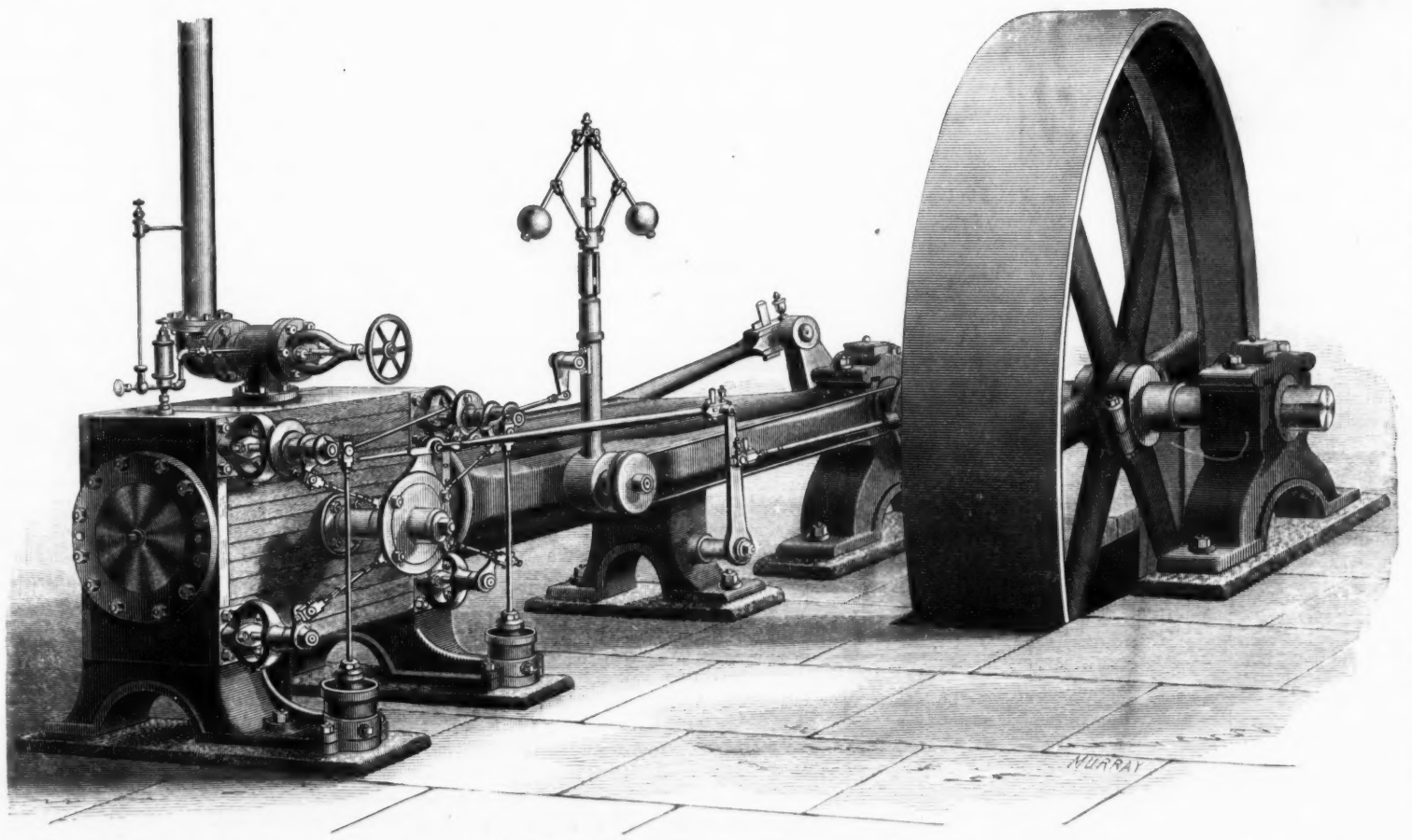
In the gear ordinarily employed with the Corliss engine, the construction is such as to lead to some inconvenience and annoyance from the parts wearing loose and shaky. The effect of the action of the releasing gear is also to slightly disturb the governor; the latter is the more serious fault, because its tendency is to impair the regulation, preventing its being brought to that degree of perfection which is desirable.

The new releasing gear designed for these engines overcomes these objections. The shock upon the governor incident to the use of the crab-claw is avoided, the effect at the time of release being unnoticeable. It is noiseless in operation. The arrangement of parts is such that the leverage to the detaching-gear is absolutely uniform under all conditions, and the work of unhooking reduced to a minimum. At the same time a long and ample bearing-surface is provided to the moving parts, with the power applied substantially in line with the resistance.

The new dash pot recently put in use is shown in Fig. 2. It is designed to secure rapid valve closure, without jar or shock.

The vacuum which serves to close the valve is maintained in the chamber above the central post. As the piston descends, closing the steam-valve, any small quantity of air that may have found its way into this chamber is displaced through the automatic valve shown in the top of post.





THE WATTS-CAMPBELL COMPANY'S CORLISS ENGINE.

The cushioning is accomplished in the annular chamber at the bottom. The piston in falling is first partially obstructed in the tapered upper part of the annular chamber; then, as it passes this tapered portion, it is more completely resisted, the only escape for the imprisoned air being such as is provided by the adjusting screw. By means of this screw any desired adjustment of cushion can be made, interposed leathers preventing the parts from striking metal to metal while making such adjustment, or at any time while in operation.

It will be noticed that the attachment of the dash-pot piston to the rod is by means of a ball and socket bearing. This permits the piston to turn freely on the central post, thus promoting uniformity of wear, and increasing the durability of the parts.

In addition to permitting revolution of the

piston, the ball and socket connection compensates for any slight fault in alignment avoiding all danger of binding; it also forms an oil reservoir, from which the oil cannot leak, thereby insuring perfect lubrication.

The oil hole in the top of the piston provides for conveniently oiling the other parts which move in contact.

The piston packing is a modification of the "spring ring" type, the modification providing for accurately centering the piston when, as it inevitably will, it gets low from wear. A center ring carries the weight of the piston, protecting the head and follower from wear.

It is necessary, for safety, that the center ring be somewhat smaller than the bore of the cylinder. If turned round, as is ordinarily done, when placed in the cylinder, the bearing will be only in a line on the bottom. This will, from wear on a small surface, soon not only locate the piston below the center, but will render cutting or scoring probable. By the plan adopted for turning the center ring the lower or bearing part is made to exactly fit the bore of the cylinder, the ring being turned out of round to give the requisite clearance. This gives full bearing surface from the start.

The packing consists of two small rings, one at either edge of the center ring. These are turned somewhat larger than the bore of the cylinder, then cut and halved together at the joints. When in place they keep in easy contact with the cylinder, without undue friction, compensating for wear by their own elasticity. Light springs are supplied, which assist in keeping the rings in contact with the cylinder until they are worn out.

The practice is to make the connecting rods of a standard length of six cranks, or three times the length of stroke. Gib and key adjustment are provided.

The manufacturers of these engines were the first builders of this type of engine to provide for keeping the exhaust steam separated from the walls of the cylinder, thus preventing the exhaust steam from robbing the cylinder of heat. This practice they have adhered to, and in all sizes of their engines the exhaust from each end of the cylinder goes to a common outlet at the center through passages entirely distinct from the cylinder proper.

Fig. 3 shows the plan of tandem compounding, with the governor connections to control the cut-off on both high and low pressure cylinders. In all essential respects the parts of the compound engines are same as those of the simple engines.

Mr. C. Brown writes us from Pozzuoli, Italy, as follows:

"The Wheeler surface condenser, illustrated and described in your paper of the 15th May, 1886, is now rather old. I have made them since 1863. They have also, I believe, been made by Mr. Perkins, under Perkins & Williamson's patent."

Efforts have been made to get a charter in Boston for an elevated electric railroad. The efforts have been opposed by numerous owners of real estate in whose behalf C. J. H. Woodbury recently submitted testimony in the form of an able review of what has been accomplished in the direction of such railroads. His conclusions are sound. They are as follows:

"Far be it from me to utter a word that could be used in opposition to any public benefit, or that would serve as a check to the progress of any invention, but the facts bearing upon the question of the application of electricity to elevated railroads show that it is still in an experimental state, as it has been for the last fifty years, notwithstanding that it has received the attention of ablest electricians and the benefit of large amounts of capital.

"Irrespective of any consideration of the exigency requiring elevated railroads over the streets of Boston, it does not seem as if there were any grounds justifying the granting of a franchise for an elevated electrical railway, which must be another experiment, and perhaps hold the occupancy of the streets against some other form of rapid transit."

Abstracts of Topical Discussions and of Papers at the Chicago Meeting of the Mechanical Engineers.

DESCRIPTION OF A VALVE DYNAMOMETER, FOR MEASURING THE POWER REQUIRED TO MOVE A SLIDE VALVE AT DIFFERENT SPEEDS AND PRESSURES.

In this paper the author, C. M. Giddings, set forth the following requirements of an instrument for this purpose:

1st. It must be sufficiently yielding to feel the variations of strains on the valve stem, and at the same time so nearly rigid that it would give a very small fraction less than the full travel of the valve, as the showing from a reduced travel or a distorted valve action would be entirely unsatisfactory. In other words, it must be rigid without being entirely rigid.

2d. It must show accurately the strains on the valve stem throughout the entire revolution of the eccentric, and not simply for one stroke of the valve. This, it is readily seen, would reverse the strains on the instrument.

3d. It must have an accurate means of recording the variations of stress on the instrument upon paper for future calculations and comparisons of different valves.

4th. It must be provided with a rigid connection to relieve the springs when not taking a card, with means to detach the same readily when under motion.

5th. It must either have means of varying the tension of the springs for different size and type of valves, or be so constructed that the springs could be easily replaced with others of different tension.

In some experiments the results were tabulated, as follows:

9" by 12" Engine, 100 Rev. 3 Ported Flat Valve.		9" by 14" Engine, 100 Rev. Equilibrium Valve.	
Brake Load on Engine.	Percentage of Load on Valve Stem.	Brake Load on Engine.	Percentage of Load on Valve Stem.
5.5 H. P.	4¼ p. cent.	11.4 H. P.	1.2 p. cent.
7. "	3½ "	13.5 "	1.1 "
8.25 "	4 "	14. "	1. "
8.9 "	6 "	15.6 "	1. "
11.1 "	7.3 "	....	.....

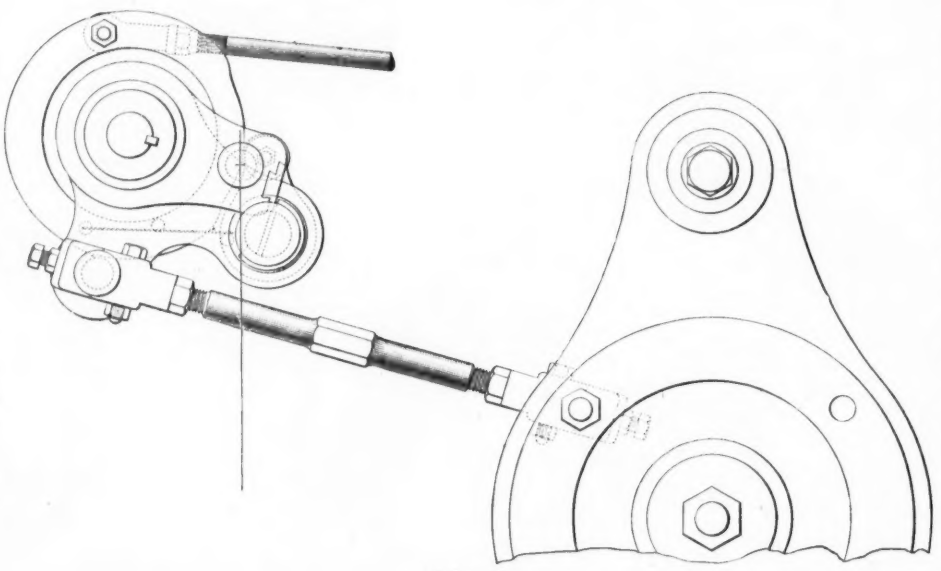


Fig. 1.

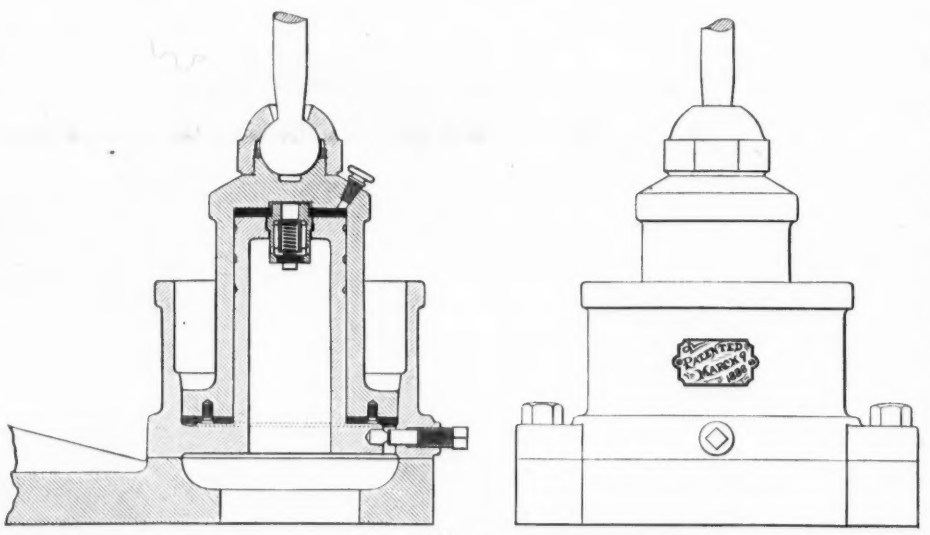


Fig. 2.

He then described, by the aid of cuts, the construction of the instrument he constructed and used, also some diagrams which were taken with it.

Mr. Babcock related a laughable experience in attempting to find by the use of the indicator the power required to drive a slide valve. The results showed that it required something less than no power. His experience had shown him that the friction of brass on iron, as between a valve and valve-face, was materially greater than between iron and iron.

Attention was called to the fact that Mr. Giddings' experiments covered only a part of the power required to drive a slide valve. That absorbed in the friction, between the eccentric and strap and in the connections, is not accounted for. It was suggested that the power should be measured by means of a dynamometer on the shaft, to which the eccentric should be connected. Mr. Kent proposed a weighing machine, consisting of large metallic disks, connected in the valve stem.

Prof. Sweet called attention to the fact that there was not room in which to connect a device of the kind illustrated by Mr. Kent.

Mr. Lewis had made experiments to show the influence on speed due to increasing the power transmitted through the valve stem.

Mr. Barnaby showed that this had only to do with governing the speed of the engine. Mr. Lewis' experiments (on a Buckeye engine) amounted substantially to a change in the governor weights, and, as a matter of course, such change results in a variation in speed.

Mr. Towne proposed driving the valves of one engine by another engine, and measuring the power developed in the second engine.

Mr. Babcock said this would introduce inaccuracies in the measurement.

In conclusion, Mr. Giddings said he was aware the subject was not exhausted. In fact, it was only opened. He was anxious to see experiments that would throw additional light on a matter so much extended. He would gladly furnish blue prints of the device which he used to any one to whom they would be of service in continuing the experiments.

THE TRAINING OF A DYNAMIC ENGINEER IN WASHINGTON UNIVERSITY, ST. LOUIS.

In this paper the author, Calvin M. Woodward, set forth the advantages of the institution named. The author argued in favor of not manufacturing articles for sale, as follows:

I think the policy of deliberately manufacturing for the market is mischievous in three ways:

1. The orders the superintendent can get, and the sequence in which he gets them, are greatly inferior in the opportunities they offer for logical treatment and fullness of instruction to the orders he is capable of designing.

2. The pecuniary risk involved in the execution of a delicate operation on a large or complicated article is liable to lead the skilled instructor to do with his own hands in every case what each student should have a chance to practice upon for himself.

3. In spite of all efforts to the contrary, the filling of actual orders is sure to involve not only a dearth of the most instructive processes, but an excess of the simpler steps, continued practice in which ceases to be of any subjective value, and which therefore results in waste of time and a loss of interest. [It must be borne steadily in mind that I am not speaking of learning a trade; I am speaking of the training of an engineer.]

Prof. Thurston offered a long written discussion of this paper. He took the remarkable ground that by the technical school system a young man could be carried further in one year than in seven years of ordinary apprenticeship. He devoted a good deal of space to description of the methods practiced at Cornell University.

Mr. Kent objected to the term Dynamic Engineer. It was introducing an expression that did not cover what was meant.

Oberlin Smith thought there was middle ground, as between throwing away all work done, and selling part.

Mr. Sinclair said that no one had greater respect for technical schools than he, but he objected to the depreciating of the apprentice question. In his business he had occasion to visit many shops and manufactories, mostly with a view to noting what was being done, and how it was being done. He found boys learning trades about as ever. They were not bound under the old rigid apprentice system, but they were learning trades all the same. He thought mechanical engineers ought to do something to help such boys along. He instanced Britain as showing what efforts should be made in establishing schools to help along those who were trying to help themselves. The great mass of experience must in the future, as it had in the past, come from the shops, and the manufactory. If he read aright the men who had made their mark in mechanical engineering had come up from the men who gained their knowledge through actual practice.

Prof. Robinson did not claim that a school was sufficient; he advised school first and the shop afterwards. He objected to the title of dynamic engineer.

Mr. Durfee believed that an intelligent weeding out was necessary whether it was in the school or in the shop. Many attempted mechanical engineering who had no aptness for it. These should be discouraged after spending sufficient time at it to demonstrate that they were not likely to succeed. He had at one time, as an assistant, a mechanical engineer fortified with any amount of parchment, who gravely submitted plans for a furnace 10 feet high to determine the value of specimens of ore. In the instance of a large building which fell some years ago with disastrous results, a test with a tack hammer, by an engineer in charge, would have revealed the weakness of the sustaining members. The columns were made on a plan that any one with practical experience would have condemned at the outset.

In the discussion of Mr. West's paper, "Irregularity in the Contraction of Duplicate

Castings," Prof. Sweet submitted the following:

One cause of unequal shrinkage in castings not mentioned in Mr. West's paper was met with in our experience, and, owing to the circumstances attending it, proved to be of an interesting character. An account of it may be valuable to some. In brief, we were casting a lot of flange pipe 8 feet 2″ long, and, with others, six 5″ pipe each day. As the pipes were cast with chilled ends, we were in the habit of testing them for length, and to our surprise we found that they varied from $\frac{5}{8}$″ to $\frac{3}{4}$″, althou h cast from the same pattern and same ladle of metal, half being long and half of the required length.

As a second peculiarity, we noticed that about one-half were usually sound and half unusually poor. It was with this lot of pipe also that we discovered that the core bars grew shorter by use, and, too, that one-half changed more than the other half.

With the above combined facts before us, it only needed the further fact that one-half of the core bars were larger than the other half to lead to a satisfactory and probably a correct solution of the whole trouble. Three of the core bars were of $3\frac{1}{2}$″ gas pipe and three of 3″ gas pipe, perforated for vent.

Take, for example, the casting for a connecting rod, when there is an enlargement at each end. In addition to the pattern itself, there is moulded in at the same time patterns in the form of what are known as "horn sprues" just inside of the projections of the enlarged ends, but not quite in contact with the connecting-rod pattern. After the pattern and the patterns of the horn sprues are withdrawn and the mould dried and closed, it will be understood that, as no metal is admitted into these cavities, the mould is weak, and the contracting metal can crush it at these points.

Rubber rollers may be turned by an emery wheel. A circular saw will also give good results, and printing press ink rollers may be nicely trued up with a fine-toothed, well-breasted circular saw.

There is a hearty goodfellowship among machinists, which seems to be lacking among workmen of some other trades.

In nearly every shop may be found some of these men who are continually on the lookout for something to be good natured over, and it seems to be a fact that these men are always "good workmen," and the best machinists in the shop.

An instance, as related by a well-known mechanical engineer, supports the above:

When this engineer was a "tramp jour" he entered a strange shop and began talking with a machinist whom he had never seen before, who was running a big lathe.

"What is the chance for a job here?" asked our tramp.

"Pretty good, I guess."

"Who is the boss?"

"Mr. Foreman is boss of this floor. Just you hang around here awhile and he'll come 'round."

As the boss approached the lathe hand stepped up to him and said: "Mr. Foreman, this is my old chum Tramp who is looking for a job; Mr. Tramp, Mr. Foreman."

Tramp and Foreman both shook hands, and Tramp got a job.

One thing that has always told against economy of coal consumption in locomotives is that there is no fairly defined standard by which to measure results. In the best stationary engine practice the amount of coal required per horse-power is fairly well understood, or perhaps has been established by actual test, hence an engineer always has something with which to compare results. If some equally satisfactory standard could be established in locomotive practice, economy would be increased.

It took a committee of Congress, and a good deal of inquiry and deliberation, to find out the plain fact that any armor plate required for ships or for coast defence could be made in this country by private manufacturers. There is nothing like finding out things by rule, and officially tying up the information with red tape.

In the older settled parts of the country railroads are built when there is, presumably, at least, some demand for them. This is a case of demand before supply. In the West this is very generally reversed; the road is built to secure a population that will make a demand for it. This is supply before demand.

Experiments have for some years been carried out in Italy to find something that would resist forged steel projectiles discharged from a hundred-ton gun. At a late trial a chilled cast-iron plate four feet thick successfully accomplished the purpose.

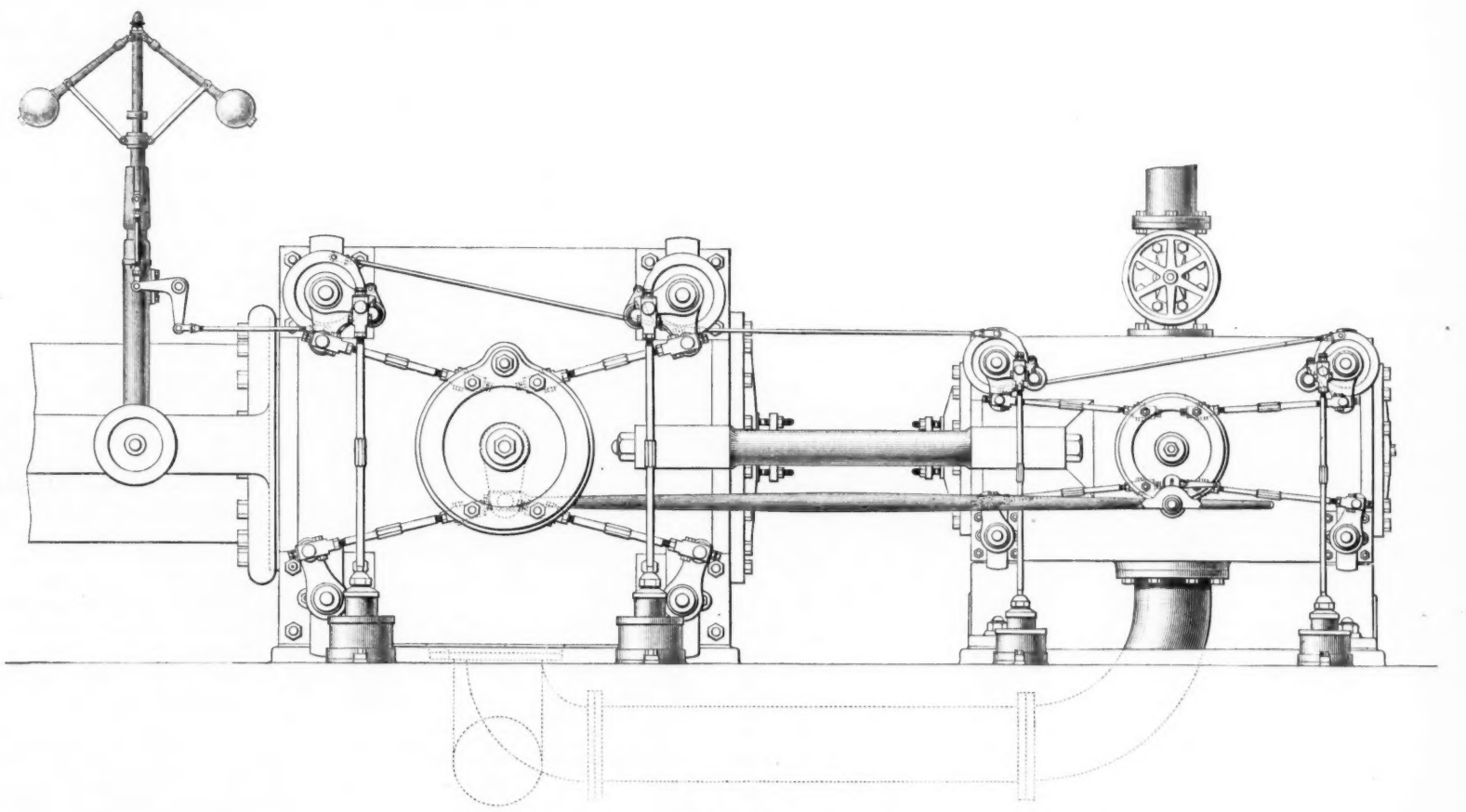


Fig. 3.

WATTS-CAMPBELL ENGINE.

My theory is that, when the melted metal first set, it bound firmly on the sand core and large core bars which resisted end shrinkage, and while this was taking place the metal of the casting was partly torn asunder, and rendered porous in the same manner as the center of a large mass is torn or made porous by the outside cooling first.

By the time the castings had cooled down and become rigid, the core bars had been raised to a red heat and become soft, so that the final cooling and shrinking of the pipe casting actually upset the core bars from day to day by its frictional grip upon them.

These actions did not take place in the case of the small core bars, or at least not to so great an extent; but if to any extent, may we not look to the core bars, and flasks even, to account for unequal shrinkage, and in some cases unsound castings?

In the case of steel castings, it is a well-known trouble that pieces of certain shapes pull themselves apart before the mould can be broken out of the way to permit of shrinkage.

While it is not strictly within the scope of this discussion, as a useful fact it may be well to explain one successful method of arranging the dry sand mould to allow for the rapid contraction in steel castings.

Stove pattern-makers would make a point by putting four, or even three, lifter holes in each lid of cook stoves and ranges.

It would be appreciated after puggling around in the dark, trying to find a place for the lifter, and the lifter hole would not then be sure to lie close to a hot kettle just where the lifter cannot engage it.

Moulding a Cop Tube.

BY JAMES F. HOBART.

To make cop tubes without cores, or without going to the trouble of making a dry sand core, seems a perplexing job at first sight, but it can be easily done.

These tubes should be made of soft grey iron, and poured open end down, the iron entering at bottom, and rising to fill the mould.

The tubes, we will call $2\frac{1}{8}$″ diameter for 4 inches in length, then tapering on a curve for about 2 inches, to $1\frac{1}{4}$″, then the end is rounded neatly off.

A three part flask must be used, the middle lift being in thickness equal to length of straight part of cop tube or 4 inches.

The tube pattern is turned bottom side up, and the green sand core rammed in. The metal is from $\frac{1}{8}$″ to $\frac{1}{4}$″ thick in the tube, leaving the core $1\frac{1}{2}$″ to $1\frac{3}{4}$″ thick, and about $5\frac{1}{2}$″ long, with a taper corresponding to that outside the tube.

After ramming up the core, set pattern on follower board, set on 4″ lift of flask, and ram up.

A gate must be set in the middle, as well as in top lift of flask. Next, put on top lift, dust on parting sand, and ram up.

Now, roll the flask over, take off follower board and put on bottom lift of flask. Some nails had better be stuck into the core, before ramming up bottom lift of flask, also rap the pattern from bottom, in order to let the top lift draw off.

Ram up bottom lift of flask, roll over and draw off top lift of cope, knock out gate plug, trim and smooth up gate and set cope one side.

The tube pattern now projects above middle lift the extent of its taper on about $2\frac{3}{8}$″. Rap the pattern and draw it out. The core will remain in place, if the inside of pattern is smooth.

Lift off middle lift of flask, knock out gate plug from this lift; also trim and slick up when needed.

Gate in bottom lift or nowel, close the mould and pour. The bottom part of tube is required to be the most perfect, and is guaranteed by moulding in this position.

Venting is done differently by different moulders. Some men run a vent wire up into the green sand core from bottom of flask, but others do not, and both methods secure good castings.

Poor Boiler Piping.

Poor piping around a steam boiler may be the indirect cause of an explosion. Boilers are sometimes piped by men who are ignorant of the simplest principles of steam engineering. Such men are sometimes given charge of erecting a steam-making plant through ignorance or penury of the owner. In such cases it is not surprising that accidents occur.

A case in point was lately brought to notice. A steam boiler was so piped that both blow-off and surface blow-off had to be operated simultaneously, and through the same discharge pipe, also through the water connection of the water-line glass.

The two blow-offs, when the outlet was closed, formed a system through which water circulated from bottom of boiler to water line, exactly as in household hot-water tanks. From this circulation the water-line pipe branched off, a branch full of deceit and treachery to the engineer.

The "Model" Tool Grinder.

The advantages possessed by the emery wheel for tool grinding are so manifest that the demand is daily increasing for good wheels, and well-arranged machines for running them. The cut shows a machine designed to meet the wants of those who wish a small, compact and low-priced machine.

These tool-grinders will be found of advantage in large shops, as well as small shops, where a number of them can be placed at short intervals, thus avoiding the necessity of making long trips to grindstones. The wheel used is $12'' \times 2\frac{1}{2}''$, and of a grade suitable to the work. Water is supplied to it from the cup surmounting the hood, and when once used is carried off with other waste. As the wheel wears away, the table and water guard may be adjusted to the reduced size. The tight and loose pulleys are on the spindle. Floor space required is $12'' \times 20''$. Whenever desired, cast-iron legs are furnished at a small additional cost. It is manufactured by D. W. Williamson, 482 East New York street, Indianapolis, Ind.

Patterns for Screws.

BY F. W. BARROWS.

For a spiral or worm, like Fig. 33, which is known as a conveyor, you will have to be very particular or you will make a failure of it. Turn up the pattern as a straight piece, one-half or three-quarters of an inch larger all over than the outside of worm. The pattern should have a length which may be evenly divided by the pitch, with the addition of the thickness of one thread. The ends should be drafted to match the taper of thread, and the ends of core box made to match.

One end of the conveyor as shown has a projecting stud, and the other a socket into which the stud would fit. On each end of the pattern a piece of the size of hub at socket end and as long as the stud at opposite end should be turned. These form prints for the cores which form the pin and socket. The ends of the thread are cut off square, that the next section at each end may be fitted to form a continuous screw.

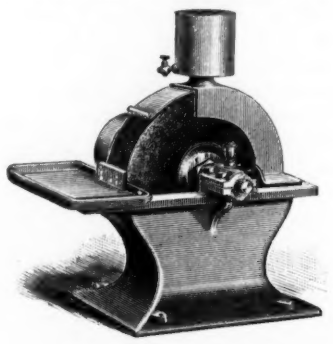
If you wish to use each length separate, making the length such as you want, you can fasten a piece of shafting in socket end, or the pin at the opposite end may be long enough to reach through bearing and into the socket on next piece.

You won't need to lay out the spiral on pattern as the core box does away with all that. Make the box a full half circle of the length from *a* to *b*, Fig. 33. First make the ends, these may be turned to the taper of screw, then put on the outside in staves, as you would for a plain round core the full diameter of pattern. Now, put two half circles on a face plate, and turn off to the same diameter as pattern, bore through the center for the piece which is to form the central shaft or core of conveyor. The thickness of these pieces will be regulated by the length of core box; one side should be turned off like one side of a section of the thread. Lay off on the joint on each half, one-half the pitch from the face side, and carry the outline of thread back to this point.

Divide the circumference of these pieces as you did the circumference of drum for winding chain, and get a line representing the correct line of thread. You must work this off by hand, and you can do it very nicely by turning a piece to fit the hole bored through center; cut through the center of this piece from one end and fasten to your template. By turning around and at the same time sliding up or down, the template may be made to reach every part of the face of loose pin, and will show you just where it wants cutting.

As this piece is larger than worm, you must make allowance for this on your template, carry the surface of spiral face right out to the full diameter of piece. After you have trued up the surface to fit template, gauge from the outside the extra thickness which we added to the diameter of pattern, and cut it down to the thickness of thread at circumference. Now, finish up the other half. This other half must now have the thickness of thread cut back at circumference, and fix them in the core box at a distance apart equal to the pitch. If you have kept all your sizes right they will fix themselves. That is, if one piece is placed against each end of the box the distance between them will be right without any further fixing.

Then the space between them will be like the space between two adjacent threads on the worm, with the addition at circumference of one-half or three-quarters of an inch, which we added to the size of pattern, and which thickness reaches across the top of thread and



MODEL TOOL GRINDER.

serves to keep the cores at the right distance apart in the mold. The loose pieces should have a feather or dovetail let into the ends of box to prevent them from turning around and destroying the core when drawing off the box.

Now, fit in the piece which is to form the central shaft of worm. This piece I should turn down to the size of shaft from *h* to *k*, leaving the ends of a size to fit the hole bored through loose pieces. This hole should be large enough to take in the full size of fillet between thread and shaft. This will make it easy to work off the face of spiral on the loose pieces, and you will also get in the fillet in good shape. This piece for the shaft must be left loose and taken out before the core is drawn.

We must now make provision for the ends of worm. The thread at each end must be cut off square, perpendicular to the axis, and also be cut so that one end may be an exact counterpart of the other, then any number

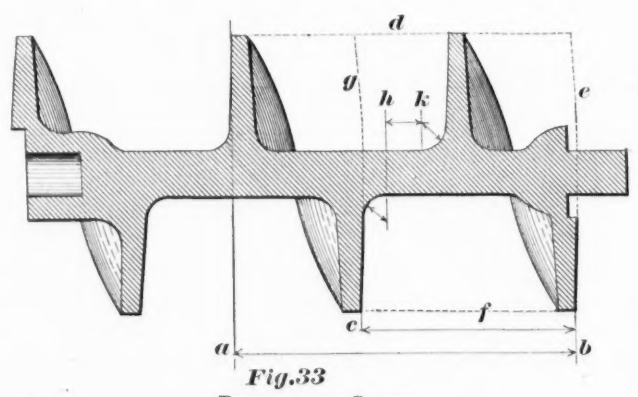


Fig.33

PATTERN FOR SCREW.

of sections may be fastened together to form a continuous screw, by means of the stud and socket already mentioned. The most convenient place to stop off thread will be at the joint or top of core box. For the box you should have besides the loose pieces already made, a piece fitted to the ends of box, and reaching from *b* to *c*. You must also have loose pieces to form the extra size of the shaft at the socket end, and also at the shoulder on opposite end.

Now, to finish the cores for the ends of spiral, you take out one of the loose pieces, and make a core reaching from the opposite spiral face to the end of box, as shown by the broken lines *d e f*, then put in the parallel thickness piece at this end of box, and you make another core reaching from the spiral face to broken line *g*. These two cores will form one end of the worm. Go through the same operation at the opposite end of core box. Don't forget on these end sections to make allowance for the extra size of shafts at each end.

If you have been accurate in the length of pattern and core box, the cores will come out even with the length of pattern. You must also have a core box of the diameter of end prints and long enough to make the core necessary for each end, with the addition of such length, as will keep the two plugs, which I should use in position, one for making the hole in core to form the pin, the other making the opposite end. These cores also form the recess shown at each end in Fig. 33, reaching to the center of thread.

Electricity for Practical Mechanics.

BY GEO. H. BENJAMIN.

FOURTH PAPER.

My last paper, which treated of the method employed for exciting the field magnets of dynamo-electric machines of the class designed for arc lighting, contained the assertion, at the beginning of the paper, that a constant speed of revolution was an essential factor, but before the end of the article I was forced to admit that no machine yet constructed was practically self-regulating. That it was necessary either to vary the speed, or brush adjustment, to meet variations of resistance in the working circuit—caused by increasing or decreasing the number of lamps at work. Hence it will be seen that theory and practice do not quite agree. In practice, constant speed is maintained within certain limits, the regulation being by hand brush adjustment, which is the most common, or by means of electrically actuated mechanical brush adjustment. Where the adjustment is by hand, an amperemeter, or similar circuit-current measuring device, is included in the circuit and serves a similar purpose to that of a steam gauge. By noting the current flowing the machine output can be regulated to required conditions.

To illustrate, we will suppose that a machine is making 1,200 revolutions; that the difference of potential at the brushes be 30 volts, and that one lamp be burning having a resistance of 3 ohms. Now, the amperemeter will show that 10 amperes is flowing in the circuit, this being approximately the quantity required for one arc lamp. If, now, another lamp be switched in, the resistance of the circuit will be doubled, the lamps being in series—that is, the current flows from one lamp to the next. Now the meter will show only five amperes, which is insufficient for the work, and the brushes must be moved up or around the commutator and nearer to the points of maximum and minimum current, until the meter again shows 10 amperes flowing. But the question is asked, "How is it that 10 amperes will operate two lamps when the same amount was required for one?" In the first instance, we had 30 volts and 10 amperes—$30 \times 10 = 300$ watts; by moving the brushes the electromotive force was increased to, say double the amount, 60 volts—$60 \times 10 = 600$ watts.

746 watts=1 electrical horse-power; so we see that while one lamp required something less than $\frac{1}{2}$ electrical horse-power, two lamps double the amount or nearly 1 electrical horse-power. Unfortunately, this again is not entirely practical. No machine that I am aware of will allow any wide variation in its designed working load. A ten-light machine will work on eight lights, and a five on four, but it is not practical, or possible by brush adjustment or even differentiation of speed, to reduce the number of lights, say to one. It is possible, by interposing artificial resistance, to do it—but it is of course very uneconomical. Where a large number of lights are employed on a single circuit, it is the common practice to couple a number of separate machines in series—throwing in or out a machine as the work increases or decreases.

Some machines, notably the "Brush" are designed to work at high potential (volts), and hence are capable of maintaining a number of lamps at a considerable distance from the station, while others, and they are in the majority, have a limited degree of potential, and can only work over short distances, or a greater distance, when two or more are coupled in series. Where two or more machines are coupled in series, they should preferably be driven from the same shafting; so that their speed of revolution shall be the same, otherwise the machine working at the greatest speed will bear the brunt of the work, and will tend to heat, spark at brushes, etc.

Some machine tenders, attempt to obviate this trouble by brush adjustment, but it is very uneconomical—for the reason that the field magnets (series wound machines) are excited by the whole current, and here work must be done in pulling the armature through the magnetic field created. Several little handy devices (preferably that made by the Electric Manufacturing Company, of Troy, N. Y.) are to be obtained in the market for determining the speed of revolution. The speed of revolution should be frequently taken with a single machine, as well as with those in series. A series of speed observation will often teach a better lesson than can be learned from a dozen technical newspaper articles. With a good speed counter and a reliable amperemeter, an observing man can learn about all that he will ever require to know, about the operation of a dynamo electric machine. There is one caution, which I desire to impress, viz.: Do not place your faith blindly on what text-books tell you; don't be too ready to blame your machine if it doesn't do exactly what the books would have you believe. The modern dynamo has passed out of the region of experiment, and is the embodied result of long pains-taking study, by essentially practical men, while text-books are more frequently the wild vaporings of theory-stuffed college professors, and the like, who, while they can write learnedly and prove anything by mathematics (to their own satisfaction, anyway), would be utterly at sea should they be compelled to operate the very machine they profess to describe.

I do not wish to be understood as objecting to conscientious study of the best text-writers; such study can but be of value. Still, it is just as well to practically demonstrate (where you can) any theoretical deductions you may find given.

The present paper is rather a departure from my prescribed path in describing the elements of dynamo-electric machines. I, however, have thought it best to mix up a little hard fact, with the (in part) fiction of theory.

A member of the New York Fire Department recently stated that since the New York Steam Heating Company has been doing business the number of fires in the districts served by the company have largely decreased.

In many buildings in which were formerly maintained many stoves, and a number of steam boilers, there is no fire now used at all.

As a proof that but few fires occur, it was stated that the company which covers the vicinity of Fulton street had not been called out for 13 days.

Hydraulic Forging Press.

A 4,000 ton hydraulic forging press is being constructed by Davy Brothers, Sheffield, England. The two main pressure rams are 36″ in diameter. The lifting rams are 9″ in diameter, and all are 7 feet stroke. The maximum hydraulic pressure used is 4,500 lbs. per square inch. Speed of ram $\frac{1}{2}''$ per revolution of pump, and 8″ per revolution of return motion. By means of an auxiliary water service a speed of 5′ per second can be given to the press.

Casings for Kettles and Pans, and How to Make Them.

BY S. BOLLAND.

It sometimes occurs that large numbers of kettles are ordered of one size. It becomes important on such occasions to have the best system of making them, in order to make the job pay as well as to make them rapidly. In the case of such as are plain, and that do not reach a full semicircle in depth, they can be made very easily in casings, which saves both bricking of mold and ramming in the pit, enabling the moulder to make a pan in very short order. Fig. 69, *A* shows section of casings for cope and core, closed and ready for casting.

The mould shown represents a 7′ 6″ crystalizing cone 3′ 5″ deep. These casings can be swept in loam and cast about 1″ thick, with holes about every 6″ all over them. These holes must be ¾″ and ⅝″ at ends, and must be placed with the small end outwards, so that the loam will wedge fast in them, and prevent their bursting out when the iron is poured in.

An allowance of from ¾″ to 1″ must be made for loam on the body and bottom of flange, the bearings and guides will do with less. Observe at *A*, Fig. 62, a projection is cast on cope casing; this serves to hold up the loam when it is turned over, and must be made as deep as possible. At Figs. 60 and 61 are seen the arrangement for spindles and sweep. The socket on the core casing is intended to be a fixture, but that on the cope requires to be taken off each cast.

The swivel is also shown at *A*, Figs. 59 and 60, and at Fig. 60 the horse is shown on which the cope is to be turned and serves as a rest while it is swept up. Let the face of casings be prickered as shown so as to bind the loam more firmly to them. Lugs may be cast on for lifting purposes. If convenient, have both casings rest on the carriage whilst they are being swept, and have them warm when you commence. After roughing on the first coat let them be dried, and should it be inconvenient to run both moulds into the oven, the cope can be dried by suspending a large kettle fire in the inside and covering over with sheet iron, this method will soon dry it. Before putting on the finishing coat have the moulds well cleaned, and use your slip thin, and be sure to rub it well in, for should there be any slack places, scabs are sure to ensue. After the sweep and spindle are lifted from the core, a loam plug can be inserted into the hole at the crown, as seen at *B*, Fig. 59, *A*. Should your spindle for the cope be about from ¾″ to 3½″ the hole left by such spindle would serve as the runner, taking care to cut a large fillet round it; this allows the iron to escape more freely into the mould when the kettle is thin.

At *C*, Fig. 59, is shown the method of clamping the moulds together to cast. Should you have to cast on the floor, you must set down on packings 10″ high. Let the top of your runner be not less than 18″ from the crown of the pan, and in casting be sure to keep the runner full from the beginning. It is important that shavings be placed all around underneath the casing, and have them blazing when you begin to pour. As you must lift the casting from the casing as soon as it is safe to do so, on account of danger from shrinkage, it is important that everything should be in readiness for quick work. To that end arrange your runner so that it can be tapped. After clearing around the gate, and the clamps are all off, hitch on to the swivels.

I have shown at Fig. 62 a handy method for lifting the casting. When the bottom of casing is hoisted as high as the bottom of the flange, clear away the loam and insert as many of the dogs (shown at *B*, Fig. 52) as will lift away the casting without warping it; screw these firmly to the casing, and the casting will be lifted as you hoist off. If you should not have a suitable iron truck to load on to at once, the casting had better be lowered on weights leveled for the purpose. As an extra precaution, when the pan is very thin and deep, the form of the inside casing may be made as shown by broken lines at *C*, Fig. 52. But when the casting is shallow and a reasonable amount of speed be made, there is very little danger of the casting from shrinkage. Sometimes the outer casing can be rigged so as to make a smaller pan than it was made for, by securing a ring around the inner edge at *A*, Fig. 62, to carry the necessary brick work. When such can be done a great saving is effected, as all that is required is to clamp down firmly to the plate which carries the core, and in all other respects proceed as directed when core casing is used.

Fig. 59 *B*, shows how to make a casing when lugs and brackets are to be cast on. In this case I have done away with the guide bearing, simply sweeping the outer guide, as seen at *A*. The bottom plate for core may be cast separate from internal casing (in open sand) and bolted together as shown by broken lines at *C*. A little different arrangement of swivels is here shown, it being just as well to attach them to two of the packets. Core forming the bracket is shown in plan at *D*, and in elevation at *E*. Bearings for the cores can be swept with core sand in each pocket to the correct height at *F*. It will be seen that space is allowed all round the core at *G*, into which (when the cores are set) sand can be rammed hard, but should this be insufficient to hold up the core, hook bolts may be used, as shown at *H*, the holes being cast or drilled into the casing for the purpose. I have no hesitation in saying the very best work can be done in casings, and pans from ½″ to 6″ thick can be made without a flaw, when proper care is taken.

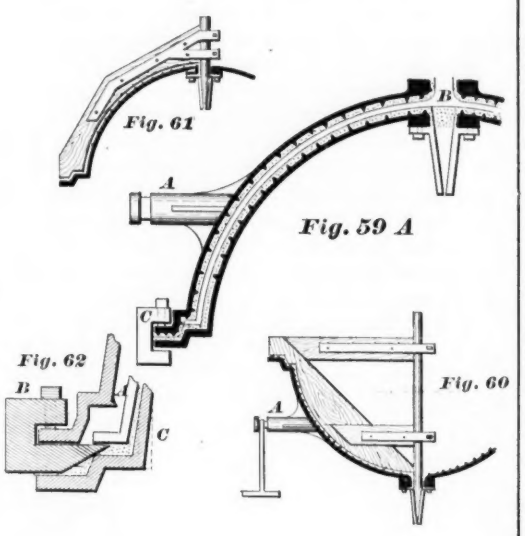
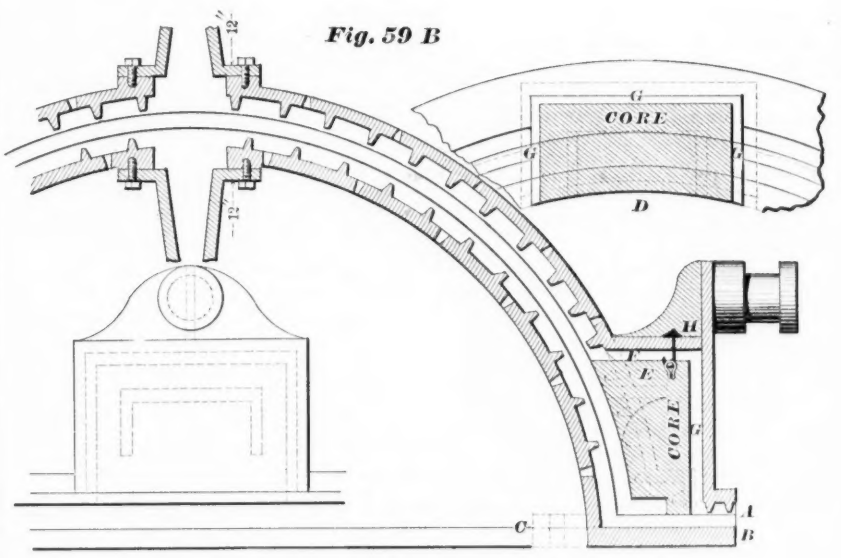


Fig. 59 B



CASINGS FOR KETTLES AND PANS.

Blow-Holes in Open Hearth Steel.

EXTRACTS FROM A PAPER READ BEFORE THE BRITISH IRON AND STEEL INSTITUTE BY JOHN HEATH, F.G.S.

Blow-holes in steel are of two kinds—those due to the contraction of the metal in cooling, and those due to the presence of imprisoned gases in its mass. With care, and by the use of proper appliances in casting, the first kind of blow-holes may in a great measure be avoided; but even when present in steel ingots, inasmuch as they form vacuous cavities, the author agrees with the generally accepted theory that they will close upon the steel being subjected to pressure under hammers, presses, or mills, provided that air does not reach them before the weld is complete. But with regard to the second kind of blow-holes the case is different; they can only be altered in form, except in so far as they may be got rid of by being brought to the surface of the metal by compression while the ingots are being worked up into merchantable forms. Supposing an ingot of steel containing gaseous blow-holes to be placed under the hammer or mill, the effect of the work done will be to compress the blow-holes, except in so far as some of them may be brought to the surface and so be removed; but the others will remain in the finished article, forming points of weakness which will show themselves on testing for tensile strain, particularly when the strain is applied transversely to the direction in which the metal has been worked. In the removal of blow-holes—those of the first kind by welding, and those of the second kind by bringing them to the surface of the metal, in working it up into merchantable forms—is to be attributed the improvement in quality which steel is found to acquire by compression after the ingot has been withdrawn from the mould.

* * * * * * *

It has been supposed that the gases forming blow-holes in steel are bubbles of carbonic oxide formed by the reaction of iron oxide on the carbon in the manganiferous iron added to the molten steel before it is poured into the moulds. This explanation, however, is open to the objection that manganiferous iron, being specifically heavier than steel, sinks immediately to the bottom of the molten metal to which it is added, being only momentarily in contact with the slag on the surface; and, further, that, as already stated, we find gaseous blow-holes or seedy boil in glass, in the manufacture of which the addition of manganiferous iron, or any material containing carbon, at the end of the operation is not practiced. If the gaseous blow-holes found in open-hearth steel are bubbles of carbonic oxide, it may have been obtained from the gas used for melting, and this conclusion is supported by the fact that blow-holes or seedy boil are found in glass and steel melted by contact of flame, and are absent when melting by radiation is adopted.

* * * * * * *

Considerable benefit accrued to the steel if after it had been poured into the ladle it were allowed to remain there under the protecting covering of slag to prevent decrease of temperature. The objection to this mode of proceeding was that, at this portion of the process, time was valuable; but he felt sure that great practical benefit would accrue if the steel could be kept in a quiescent fluid state for a quarter of an hour before pouring Of course it would not do to leave steel for a quarter of an hour in the ladle; it would partly set or become plastic if that were done.

* * * * * * *

There can be no doubt that by manufacturing open-hearth steel free from gaseous blow-holes the metal produced will be much stronger and more reliable than that made by contact of flame, and the result will be a greater confidence in its use. The merit and utility of the invention by which this may be effected are enhanced by the consideration that the production of steel of superior quality by its means is attended with considerable saving in cost of construction, in wear and tear of furnaces and in waste of metal, the yield of sound bars or plates from a given weight of ingots being considerably more than was attainable with steel melted by contact of flame.

High Temperature Thermometer.

It has been stated that thermometers with platinum or porcelain bulbs have been made for use in furnaces, or where ordinary pyrometers would be used.

The bulb is filled with air, which, when expanded by heat, acts directly against a column of mercury, from which the degrees of heat may be read, as in an ordinary thermometer.

The city of Brooklyn, with its 700,000 people, is entitled to twelve free scholarships in Cornell University. The Superintendent of Schools found but nine to accept the free scholarship privilege last year. This year but seven came to the examination for appointments as free students, five of them being gentlemen and two ladies. The fact does not indicate that Brooklyn does not appreciate the benefits of education, for that city is well supplied with educational institutions for both sexes, and they are well supported. It indicates that Brooklyn does not appreciate the educational advantages of Cornell University.

Extravagant Oil Economy.

The engineer who shows the best oil record does not always show the best economy in cost of repairs and material.

Carrying the oil supply down to the lowest amount possible is too much like running a steam boiler on a low margin of safety.

As long as the "unexpected does not happen," the engine and boiler may work well but a little heavier load, or a few pounds extra steam, will cause disaster, which years of close oil economy can never repay.

Making Long Spiral Springs.

The length of spiral springs is generally limited by the arbor on which they are made. By means of a wire, as described in the AMERICAN MACHINIST of Nov. 14, 1885, small spiral springs can be made of any reasonable length under a hundred feet, or perhaps even more.

A method of forging thread on bolts and screws, has been tried, by which method the thread is formed by two small wheels which are pressed against the hot iron, and which stand at an angle to the axis of the bolt, corresponding to the pitch of the thread to be made.

One of the wheels is placed upon the front of the bolt, the other wheel opposite the first and of course making an angle with it, equal to double the amount of pitch.

Spiral springs can be made by precisely the same method. The wheels may be mounted in the required position either side of a short arbor which may be caught in a common lathe chuck.

The wheels, which are grooved upon their face to fit the wire, are placed a distance from the arbor, equal to diameter of wire to be made into springs.

The angle at which the wheels stand being adjusted to the required pitch, a turn is taken around the arbor with the wire, the wheels are clamped in place and the lathe started.

The wheels give the required pitch to the spring, also "break" it down to fit the arbor, and at the same time, draw the completed spring from the arbor as it is completed.

By providing a trough or pipe to support the spring as it comes from the arbor, a spring may be made hundreds of feet in length.

Shops of the Chicago, Alton and St. Louis Railroad.

At Bloomington, Ill., 145 miles southwest from Chicago, and about midway between Chicago and St. Louis, the principal shops of the Chicago, Alton and St. Louis Railroad, better known as the Chicago and Alton, are located. These shops have been built within the past six years under the supervision of Superintendent of Machinery Wilson, and while not so large as some other railroad shops in the country they are in their way a model after which some copying might be done to good advantage. They are provided with better facilities for repairing and building locomotives than any other shops we have ever visited, and the system upon which work is done is equal to that of the best manufacturing establishments in the East. Their capacity is equal to doing the repairs upon the 228 locomotives owned by the company, and to building something more than one locomotive a month. The building of new locomotives is here brought up to the duplicate manufacture of parts, and the assembling of these parts without regard to number or other distinguishing marks to make the complete machine. The system of duplication adopted here also brings the repairing of locomotives to the substitution of duplicate parts for those worn or broken, as nearly as it seems possible to do.

When Mr. Wilson, about six years ago, took charge of the mechanical department of this road he found a great variety of locomotives, no two of any variety being alike in the sense of interchangeability of parts being possible. The requirements of the road had outgrown the capacity of many of these locomotives, and he brought about their sale.

In the construction and operation of the present shops the intention has been to make them the central shops of the system, from which to distribute finished parts to the smaller shops as well as to do repairs and to build locomotives. To this end manufacturing by the duplication of pieces—sure to fit—was essential, and this feature has been developed to an extent that would hardly seem possible in work of this kind.

Of the buildings the machine and erecting shop is the one deserving of the most attention, as it is here that the efforts must culminate. This shop, as is the case with all the others but one which was left of the old shops, is of stone, and of the most substantial character. It is 404 feet in length by 110 feet wide, one story in heighth. One side is entirely devoted to erecting, and has a capacity for 18 locomotives. The entire space devoted to erecting is covered by two Yale & Towne overhead traveling cranes, each having a capacity of 22½ tons. The two trolleys of each crane may be worked together or independently as desired. In lifting a locomotive the two cranes are brought together, and working in unison the operation is quickly performed, and with the least possible expenditure of muscle.

The locomotive frames are set up between the erecting pits, and cylinders and smaller parts attached. One of the cranes does all the lifting and moving of everything that one man cannot readily handle, then when the work here is completed it takes up the frame and attached parts and sets in on stands over the pit. Henceforth till the completion of the locomotive one of these cranes is brought into requisition for placing the boiler, smoke stack and various parts that must be lifted to place. It looks like a reversal of the old adage about setting a boy to do a man's work, to see one of these cranes pick up a piece that weighs no more than one or two hundred pounds, but it does this so expeditiously that there seems nothing amiss in it. These cranes are in such constant use, traversed from one end of the shop to the other, that the space in which they work must not be cumbered by smaller cranes. A point well thought of in the arrangement of these cranes was in placing the overhead track at such a height that material, or parts of locomotives, may be carried along from one end of the shop to the other above the locomotives being erected. This is a great convenience in distributing material.

The center section of the shop is covered by three 5-ton traveling cranes. Material—castings, forgings, etc.—is brought in on tracks entering at the side, and distributed by means of the cranes. In the carrying along of the parts from one machine to another while work is being done upon them, and finally placing the completed parts where they belong, there is an entire absence of trucking, or trundling, or moving by main force, and a corresponding reduction in the number of workmen required for this work. No jacking up of engines is necessary in these shops.

The heavy tools are placed along the center section of the shop, so as to be easily reached by the five-ton cranes. These tools are mainly standard railroad shop tools, but there are one or two notable exceptions. One of these is in the instance of a large milling machine, built by Bement & Son from the designs of Mr. Wilson. It is, we believe, the only one of the kind in the country. The distance between uprights is something more than six feet, and it is heavy and powerful in proportion. We noticed cutters for use on this machine eight inches in diameter, and in some instances of seven or eight inches in width. Amongst other things this machine is used for milling out cylinder ports, for milling around the valve face, and for boring out the saddle in which the smoke box rests. Platen saddles in which driving shafts rest are placed, six driving shafts put in, and the six key seats milled at one operation. This machine is found a very efficient tool for much other work usually done on a planer.

We also noticed a heavy slotting machine, so made that four sides of frame are slotted at one operation.

Throughout, the plan is to operate on several pieces at once, instead of on one separately. For instance six cylinders are planed at once, and more of smaller pieces.

The standard crossheads for road engines, are cast with a projection at the back end, which is turned exactly the size of the mandrel on which they are planed, and true with the taper hole for rod. The mandrels used in planing the crosshead are double-enders. The mandrel as well as the projection named rests on saddles, thus permitting a string of crossheads as long as the planer platen to be planed at once.

The lighter tools are placed in a section of the shop which is reached by two traveling cranes, each of one ton capacity. These most expeditiously place work in the lathe, and remove it when completed. Altogether the crane system, which must be seen to be appreciated, is a model in its way, and the whole arrangement, including the convenient placing of tools must have involved a good deal of study and thought.

Two standard locomotives were provided for in the plan of duplication; one a road engine and the other a switch engine. The latter is 16″×22″, is equalized fore and aft and will in an emergency do good work with a train on the road. The road engine is 17″×24″. Standardizing, the road engine for instance, is as all who have tried something of the kind, a matter requiring a good deal of attention. It is comparatively easy to make many of the parts—say a majority of them—to standard dimensions, but there are others that present difficulties. For example, if a cylinder is to be replaced by a new one, sizes and dimensions must correspond, holes must be located so that the new cylinder will, in this respect, take the place of the old one, and the smoke box must seat in the saddle correctly. This latter end is accomplished by, in the boiler shop, riveting the front ends of the boilers to rings accurately turned to dimensions. Then the work on the cylinder all having been done by accurate templets the new cylinder will not only take the place of the old one, but will fit either end foward, the vertical and longitudinal measurements all being correct, and the holes matching without reaming. In erecting locomotives no line is drawn through the cylinders, the templet system rendering this unnecessary. It may be here mentioned that every sheet in a standard boiler is made on the duplicate plan, and will fit exactly in any other boiler of the same class. A fire-box, kept in stock, will take the place of any other fire-box which is found in bad condition, and could be confidently sent to the end of the road if it were required, and put in there with the assurance that no fitting would be needed. In planing crossheads, a hardened templet is made fast to the work; it is impossible to plane below this, and if the planing is not done down to gauge, the templet will not go over the work. Driving boxes are fitted to a templet, bore as well as sides, and in erecting, a light templet takes the place of the heavy box, the latter not being put into place until it is put there to stay.

The five sheets which form the sides of a tender are exact duplicates, one of the other. One sheet in stock, with holes all punched, will, by bending, take the place of any of these five sheets. Manufacturing by duplicate not only reduces the cost, but its other advantages may be shown by a single example: In one instance a locomotive went down the bank, fourteen or fifteen freight cars being piled upon it and burned. The agents of the insurance company, upon careful inspection, conceded the highest insurance taken on a locomotive. This engine was in the erecting shop just one week, when it went to the roundhouse, and in two or three days was ready for the road.

The only real difficulty in bringing about the standard is in the instance of the old locomotives. When repairs are done upon them, standard parts are introduced whenever it is possible, and in this way they are worked along in the right direction.

The forge shops are well arranged for the work to be done. A large, a small and a medium-sized steam hammer are used. We are informed by Mr. Wilson that forgings—large and small—are charged to the different departments at a uniform rate of 3½ cents per pound, and that this yields a profit to the forge shop.

From the foundry castings are charged out at 2 cents per pound, but are made at considerably less than that price.

Amongst some of the arrangements hastily noted is that of the fans, two in number, for the blacksmith and boiler shops. These are situated in the building—mostly underground—entirely distinct from the shops. This avoids the noise incident to their operation. The fans deliver air into what may be termed a three-way brick valve, from which gated pipes lead to the blacksmith and boiler shops. One fan can be shut off when desirable. An extra fan stands ready to be substituted for one that may be disabled. A wind pipe runs down each side of the boiler shop, and means are provided at convenient intervals for attaching forges for heating rivets, etc. At these points forges can be readily attached, bringing them within convenient distance from riveters.

The tool room is used simply for keeping tools, that is, no work in making tools is done in it. Here the small tools used in the shop are kept, and the extensive line of jigs, templets and gauges, which cover everything done in the machine and erecting shop.

In connection with the work done in these final shops, we noticed that a great many holes, ordinarily drilled, are cored to size. This applies to cylinder heads, steam-chest covers, dome covers and the like. We are informed that with well-made cores this work comes as satisfactorily as if drilled, and saves time and the use of machine tools.

Very complete accounts of the mileage service of the various parts, such as wheels, etc., are kept. The monthly locomotive report is made out as per annexed blank.

The conditions of apprenticeship show that the intention is not to keep boys who do not show some aptness for their work. This is manifestly right. We understand that in the instance of working short time in the shops no reduction is made in the pay of apprentices, and the right to discharge is simply a protection against improper conduct.

Mr. Wilson is making careful experiments with his expansion gear for locomotives, to determine exactly what, if any, its advantages are as compared with the link motion. The link motion of his standard locomotives is very well schemed, and gives for the link motion excellent steam distribution. This we can say from an examination of a good many diagrams taken from his road locomotives. If he shows gain over his standard locomotives by his new motion, it will have shown itself superior to the best present practice with the link.

As at present constructed he uses two valves working against the opposite faces of what may be termed a mid-feather section, vertical in the steam chest. One of these valves is for steam, controlling lead and expansion, and the other for exhaust. The two valves are worked, for both motions, by a single eccentric. This gives room for large bearing surface in the straps. The eccentric is turned so that its outside surface is a section of a sphere of 7½ inches radius, and hence will accommodate itself to want of alignment as from one wheel being lower than the other, without side thrust, or injurious twist of the parts of the valve gear.

The steam valve is double-ported, each port being 9 inches in length; the exhaust valve has three ports, each 10 inches long. By this means the valve travel is reduced to 3½ inches.

Cut-off and exhaust opening and closure are readily equalized, the former having practically the full range of the stroke, while the latter can be adjusted from half to full stroke, and when adjusted will be constant for all

CHICAGO AND ALTON RAILROAD.

Locomotive Report for February, 1886.

MILEAGE.	
Passenger engine train miles	132,733
Freight " " "	226,906
Switching and pushing engine miles	97,605
Construction engine miles	14,284
Miscellaneous " "	.....
Total	471,528
Passenger car mileage	716,493
Freight " "	4,715,985
" " loaded	3,283,892
" " empty	1,432,093
" " reduced to loads.	4,238,620
Average freight train reduced to loads	20·78
" passenger train	5·40
Number of engines	212
Average mileage per engine	2224

Pounds of Coal Consumed.	
Passenger engines	11,597,754
Freight "	19,826,270
Switching and pushing engines	8,528,390
Construction engines	1,248,086
Miscellaneous	.....
Total	41,200,500

Passenger Engines.	Cost, including Switching and Pushing.	Freight Engines.
$10,357 33	For engine service	$27,794 67
6,194 31	" repairs	13,682 44
8,257 89	" fuel	17,240 53
954 24	" oil, waste and tallow.	2,103 44
$25,761 77	Total	$60,821 08

Cost per Train Mile, including Switching and Pushing.		
7·80 cts.	For engine service	12·25 cts.
4·67 "	" repairs	6·03 "
6.22 "	" fuel	7·59 "
0·72 "	" Oil, waste and tallow.	0·93 "
19·41 "	Total	26·80 cts.
3·60 "	Cost per car per mile	1·43 cts.
17·38 lbs.	Coal per car per mile	6·49 lbs.
	Total cost per train mile	24·07 cts.

Cost for passenger service	$23,913 22
" freight "	44,184 13
" switching and pushing service.	18,485 50
" construction	3,614 86
" miscellaneous	.....
Total expenditures	$90,197 71
Material "	$38,681 85
Labor "	51,515 86

The cost of all switching and pushing engines included in freight and passenger expenditures.
1-10 added to passenger service.
9-10 added to freight service.
Three empty cars reckoned as two loaded ones.

One Cord Wood. Wood, $1.75 per cord.
One Ton Coal. Coal, $1.27 per ton.
Average price of fuel per ton, $1.32.

WM. WILSON,
Supt. Machinery.

points of cut-off. The lead also remains constant.

The details of this valve gear are excellently well worked out, and we shall watch its record with interest. Whatever this may be as compared with the link, it will be of undoubted value to master mechanics.

It will be noted that the cost of switching engine service is proportioned and included in expenditures for freight and passenger service. This appears to put the cost where it belongs, so as to avoid useless calculations.

A fair number of apprentices are taken in the works. There is nothing of the old bound system attempted. The conditions annexed will give a good idea of the plan pursued:

CHICAGO AND ALTON RAILROAD CO.

Conditions of Apprenticeship.

Apprentices will be received by this company only upon the following conditions:

All applicants must serve three (3) months on trial, to demonstrate their ability to become good workmen. If then accepted, their names will be registered as apprentices for the continuation of the term, which will be three (3) years and three (3) months from the time of their acceptance, and their compensation will be as follows:

For first	3	months on trial,	55	cents per day.
" next	12	" "	55	" "
" "	15	" "	75	" "
" "	12	" "	$1 10	" "

All lost time exceeding one week in each year, unless in consequence of injuries received while in the company's shops, must be made up before the apprentice enters upon the next term.

The company does not require the parent or guardian of the applicant to sign an indenture, and does not guarantee continuous employment to any apprentice, reserving the right to suspend or finally discharge at pleasure.

All apprentices must be subject to the rules and regulations of the shops, and their parents or guardians will be required to sign formal orders permitting their children or wards to receive their wages from the company, as earned.

WM. WILSON,
Superintendent Machinery.

June 1st, 1881.

Studying American Railroads.

French railway engineers are evidently convinced that considerable benefit is to be derived from studying American railroads.

In 1885, a French engineer visited several American roads, and particularly examined the New York Central. During the first week in June, 1886, three engineers visited this railroad, and inspected its working, in company with the superintendent of motive power, Mr. Buchanan.

The three visitors were Charles Baudry, superintendent rolling stock of the Paris, Lyons and Mediterranean Railway; A. De Tonboun, superintendent motive power and rolling stock of Northern Railway of France, and Edward Sauvage, manager Locomotive Works, Northern Railway of France.

Richard M. Hoe.

Col. Richard M. Hoe, whose death occurred at Florence, Italy, June 7th, at the age of 74 years, was an inventor of more than ordinary note. He was the son of Robert Hoe who came to this country from England in 1803 and started to build printing presses in 1805. When Richard was 15 years old he went into the shop to help his father, and acquired a practical knowledge of mechanics. He began early to experiment upon improving the details of the printing press, and at the age of 25 invented a double cylinder press by which nearly twice as many copies could be worked off in the same time as by his father's press.

In 1846, after the death of father, he became head of the establishment of R. Hoe & Co. In this year he invented his "lightning" rotary press, which printed 10,000 copies an hour on one side. This was the greatest printing press in the world until, with one of his partners, L. D. Tucker, he invented the web perfecting press, which prints 20,000 to 25,000 copies an hour on both sides at once. Since the invention of the web press, about 15 years ago, a number of improvements have been made.

About 30 years ago Col. Hoe established a free evening school for apprentices in his work. For some years he gave his personal supervision to the school. The school is still kept up. Col. Hoe was a man of public spirit and charitable disposition.

LETTERS FROM PRACTICAL MEN.

Heating Feed-Water By Exhaust Steam.

Editor American Machinist:

In June 12 issue of AMERICAN MACHINIST Mr. John Coffin takes up the feed-water quesion, and on page 6 puts the following query:

Units of heat from 32° in 1 lb. of steam at 80 lbs. pressure	1177
Units of heat from 32° in 1 lb. at 20 lbs. pressure	1151
Difference	26

Where do the 26 units of heat go to if not to superheat the steam?

Suppose Mr. Coffin has a vessel containing steam at 20 lbs. pressure, and suppose he wishes to increase the quantity of steam in that vessel until there shall be 80 lbs.; or suppose he compresses the steam into a smaller volume until there is 80 lbs. pressure, how is he going to accomplish it without the expenditure of mechanical force? And suppose he makes use of his 26 units of heat to produce his force when he has finally obtained his 80 lbs., how much of his 26 heat units will he have left for superheating?

The whole thing resolves itself into this: Put a thermometer into your exhaust, and if it shows 220° you can get your feed very near it with a proper heater. If you are not sure of your thermometer put it into boiling water and then into the exhaust and note the difference.

The parties claiming that water can be heated above 212° with exhaust, without back pressure, claim that in many cases the exhaust will show on an accurate thermometer a temperature above 212°, and where it does not show it, it cannot be done. Engineers can try for themselves.

W. E. CRANE.

Coal Tar as a Substitute for Rosin in Making Cores.

Editor American Machinist:

I do not believe that all moulders know that coal tar will answer the same purpose as rosin in making cores, or they would use it. It is much cheaper than rosin, and by its use the time of a man for an hour or two in pounding up rosin is saved. All that is required is to get the sand dry and mix in the tar till of the right consistency; experience will soon teach what this is. I have used this for 25 years, and for small cores it cannot be beaten.

The reason I say small cores is because I have never tried it for large cores, but I see no reason why it should not be equally valuable for large cores. I wish some one would try it and let us know the results.

THOMAS WATHEY.

Overhauling Westinghouse Air Pumps.

Editor American Machinist:

I had occasion recently to overhaul a "standard 6" Westinghouse" air pump. I put in new air receiving and discharge valves, new rings on main steam valve, new reversing steam piston, and a new reversing valve and bushing. (The old bushing being worn so much that it could not be rebored.)

I will state right here, that a reversing valve and bushing can be used satisfactorily, when the hole in the bushing exceeds the diameter of the valve $\frac{A}{32}$" by using the same radius in turning the valve, that you have in the bushing after it is rebored and when the valve is in place, the steam will support it against the ports. You will be surprised to find how much wear can be had from them after they have been thrown in the scrap heap once.

After putting the pump together and placing it on an engine to test I started it to work, and what did I find? That piston would go down home, and stay there, at every stroke, and I had to stand by and hit it a blow, before it would make another start.

Now instead of taking that pump down to find the cause of this, I consulted an air brake instruction book, and in five minutes time I had discovered where the trouble lay.

In overhauling the pump, I had neglected to examine the reversing plate (No. 10). I found it so badly worn on the bottom side that it failed to catch on the reversing rod to reverse the stroke in time to prevent the piston from striking the bottom head. (As Mr. Paxton's did). Only in this case it hit so hard it would not start without some assistance. I removed the top head of the steam cylinder, and bottom head of the air cylinder, raised the piston to the top of its stroke, and blocked it there; changed the old plate for a new one, replaced the heads, and the pump worked as well as when new.

C. SCHENCK.

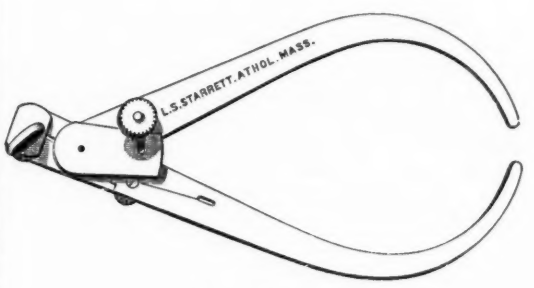
Hornellsville, N. Y.

That Air Trap.

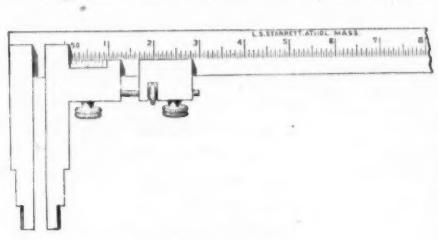
Editor American Machinist:

Prof. Sweet gives (June 12), I have no doubt, the correct explanation of the air trap question, and a remedy which may also be correct; but I think I can offer a better remedy. In an instance I have in mind, the pipe was something as represented by Prof. Sweet's sketch, except that it left the tank further up from the bottom. It then turned directly down from an elbow, the vertical pipe being 17 feet long, then an elbow and a horizontal extension of 200 feet or more. There was a plug as at *b* in Prof. Sweet's sketch. This worked all right till the water in tank got below outlet; then when the tank was pumped up the trouble began. I took the plug at *b* out, and it started right; but to fix it permanently I put a T in place of the elbow nearest the tank, and ran a pipe up as high as the top of tank. There was no further trouble.

HUGH HART.



LOCK JOINT CALIPER.



VERNIER CALIPER.

New Tools for Machinists.

The Lock-Joint Transfer Caliper shown herewith in addition to common use may be used inside of chambered cavities, over flanges, etc., removed and replaced without losing the size calipered. This is done by loosening the nut, binding one arm to auxiliary leaf and swinging it out or in (while the joint is locked) to clear the obstruction, then moving it back again against a stop where it will show the exact size measured.

The vernier caliper has dimensions as follows: Beam 12 inches long, 1 inch wide, $\frac{1}{8}$ inch thick; capacity, 9 inches; jaws $3\frac{1}{2}$ inches long, ends hardened. Beam is graduated 9 inches, one side 64ths, the other 50ths, with vernier reading 1,000ths.

One edge of beam is unobstructed and may be used in corners or as a straight edge. On the 64th side of stocks are two indicator marks, one showing outside, the other inside measure (saving mistakes liable in deducting width of jaws). This caliper is made also without vernier and some without adjusting screw.

The manufacturer is L. S. Starrett, Athol, Mass.

Straightening a Cotton-Press Screw.

As cotton-press screws frequently get badly bent, says a correspondent of the *Blacksmith and Wheelwright*, it would be a great saving to the gin owner if the neighboring blacksmith knew how to straighten them, for if the job could be done at home it would not have to go to the factory or machine shop, entailing a great loss of time and expenditure of money.

Of the many screws I have straightened during the last sixteen years I will select one which was the worst case of all. It was a $4\frac{1}{2}$-inch screw, bent in a circle between both ends, which remained in line by being held in nut and guide. I began by heating in my forge, and making rather a long heat at bend just above the nut. Having a place prepared, I placed the end under a sill and over a block of wood (to prevent injury to the thread), the block being placed underneath near the crook. By pressure on the outer end I brought it in line with the central part of the screw; then I treated the other end in the same manner to bring it in line with the middle of the screw, making a continuous curve from one end of screw to the other.

Next, I heated it in the center, getting as long a heat as I could, and continued to straighten till I reached the straight place where the nut rested, being careful all the time not to bend the screw beyond a straight line.

When the whole length of the bend had been worked up as true as possible, and had got cold, I made a tool to act like a caulking iron.

This tool has the point made a little thinner than the space between the threads, and is about an inch wide. It is hardened and tempered to a deep blue. With a heavy hammer and straight-edge I was ready to finish. I laid the screw upon blocks, turned it, and sought the low places, always keeping the bow down. Then by setting the tool between the threads I drove the metal in, thereby stretching and bringing it to a straight line.

Setting the metal up between the threads renders the screw as stiff as when new, and as little liable to bend again. My price for the job I have described is $5, and for less complicated ones $1.50.

Getting Tired.

The *Sunday Mercury*, in the interests of health and longevity, advises "cessation from work when mind or body grow the least weary." This would, perhaps, be pleasant medicine, but entirely an impossible one. We venture to say that the editor who wrote it has been heartily tired a hundred times, and that it has not done him any harm either. Good hard work, till the worker feels decidedly tired, if proper rest is taken after it, is not as likely to kill a man, or shorten his days as no work at all. Mechanics may take consolation from this, as they expect to get tired every day. But there are circumstances in which sickness is likely to come to shopmen through getting tired, that is when they are compelled—as they too often are—to breathe in unventilated shops and amidst unpleasant odors. More sickness of shopmen may be traced to this cause than is readily imagined. When impure air must be breathed for ten hours a day it is undoubtedly important that the efforts of the system to resist disease should not in any way be weakened, hence workers in such rooms should not get tired.

If proprietors of shops would study the science of ventilation, and put the knowledge gained to practical use there would not be so much sickness amongst the men, they would live more years and it would not do them any particular harm to get tired. Morever, they would have to work harder to accomplish this.

Paper roofs for buildings are now made, which are said to be superior to anything heretofore used. They are made fireproof, and it is believed they will last almost indefinitely.

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☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

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NEW YORK, JUNE 26, 1886.

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The Cost of Details.

Keeping an accurate account in such shape as to be readily referred to, of each particular piece of a machine is something that has received but very little attention in machine-shop practice in this country. In many instances in the actual cost of the entire machine, the factor of guess-work comes in; in others, where this is known with reasonable accuracy, the cost of the separate details is a thing of mystery, which it is not possible to dig out of the books. In many respects the cost of details is the most important part of the subject. It often becomes necessary, to meet competition, to reduce the cost of a machine, or it is advisable to do so to increase sales. Attacking this in a wholesale manner is quite unsatisfactory. There is but one successful way of coming at it—that is, item by item. It is astonishing how much cost may sometimes be cut down in this way without in the least reducing quality. A piece may be found upon which a good deal more machine work is done than is in any sense necessary, and another in which the processes of working up are not the best, and so on, perhaps, through two-thirds of all the pieces. The work put on these pieces, and the processes of doing it, are probably part of the original and hasty plans for getting out the first machine, and have got settled as proper enough, because the cost of parts has never been seriously considered. Lopping off cost here and there gives a total result that could not have been accomplished by hammering away at the cost on general principles.

In England and Scotland—in fact, in most or all European countries—this matter has received much greater attention than it has in this country, mainly because it has been more a question of necessity there than here. In the past, profits in manufacturing have been greater in the United States than anywhere else, and manufacturers have not been obliged to scan the details of cost very closely. To do so is the rare exception rather than the rule now.

But there is every evidence that this is to be done more in the future; it is coming to be necessary here as well as elsewhere. At the Chicago meeting of mechanical engineers a good deal of interest was manifested in the subject, and it was the unanimous expression, by vote, that the economy of manufacturing was a suitable subject for presentation and discussion at the meetings of the society. While the discussion at Chicago was not of a kind to be very valuable in the way of having special application, it clearly showed the interest of those present; beyond doubt, this interest will, at future meetings, find expression in a way that will be valuable in the directions indicated. There is no one more likely to have ever before him the cost of making what he devises than the mechanical engineer.

We believe that in many machine-shop enterprises in this country it would be decidedly profitable to employ a competent man to give his whole attention to finding the cost of small details of machines, and why they cost it. In some European shops several—in one instance we have in mind—five men are employed for this purpose, and we have been informed that the plan was found to pay well. When it is found that a machine is costing too much to keep on the market, it is a good plan to try a little of this kind of work over the details. It may be found that this is a more satisfactory way to reduce the cost than others that must otherwise be resorted to.

A Law to Enforce a Law.

The act of Congress passed Feb. 26, 1885, prohibiting the importation of contract labor from any foreign country into the United States, has not been enforced. The Commissioner of Emigration of the State of New York has called the attention of the chairman of the Labor Committee to its regular and persistent violation. He says: "I am prepared to show that the law is violated with impunity. This Board has called the attention of the United States District Attorney to the repeated violations of the act, and requested his aid in the matter. The District Attorney absolutely refused to interfere or to aid in the enforcement of the act." The question may well be asked, whether this District Attorney represents the United States Government, of which he is an official, or the cormorant corporations that are importing ship loads of Huns and Italians, in violation of law. Evidently he is not a fit man for the office. We are glad to see that Chairman O'Neil, of the Labor Committee in Congress, has acted upon the suggestions of the Commissioner of Emigration in introducing a bill to amend the act so as to give the Board of Commissioners power to prohibit the landing of any person imported under contract to labor. Its prompt passage will probably insure the enforcement of the law, but it reflects sadly upon the execution of laws by the general Government, when supplemetal acts must be passed to throw the burden of preventing the violation of United States laws upon State officials. If the new bill becomes a law, the Commissioners of Emigration can send back laborers imported under contract; and they can examine emigrants to determine who are imported with passage pre-paid.

Machinery by the Pound.

A manufacturer was recently relating his experience in buying machinery by the pound. He had tenders from two parties. From one the price was six and one-quarter cents, from the other six cents. Although inclined to favor the highest bidder, a quarter of a cent per pound on several tons weight was not to be overlooked, and somewhat reluctantly he gave the order at six cents. A year or two later he satisfied himself that the weight of machinery he purchased was 20 per cent. greater than if he had bought at the higher price per pound, and this extra weight was quite unnecessary for any purpose whatever. He figured up a loss of a few hundred dollars, but considered the experience worth more than it cost.

Prison Labor on Public Work.

Prison convicts in Texas have been jobbed out to contractors, and a gang of them have been laying steel rails on the Central Railroad. Some years ago the convicts in the Dannemora (N. Y.) Prison built a railroad for the State from the prison to Plattsburgh. The road was then presented to a prominent politician in consideration of "one dollar a year." The question naturally arises, Why should convicts not work for the State in building railroads where needed, instead of for contractors? If the State does not want to operate the railroad, it can be leased for some reasonable rental to a private company, so as to make convicts pay the expenses of keeping themselves. Some prison economists dodge the fact that convicts can do as much and as good work for the State as for private parties. Of course, the State cannot sell manufactured goods as well as private parties, and the so-called "State account" system of employing convicts makes worse competition for free, honest labor than the direct contract system. Convicts should not be employed in making anything to be placed upon the market, and sold either for the Government or for contractors. The interests of free labor demand this. Any State can find employment for all prisoners upon public work. The wealth and power of the contractors' ring has heretofore prevented this—the only true settlement of the prison labor question.

In conversation with Mr. Bushnell, master mechanic of the Burlington, Cedar Rapids and Northern Railway, he expressed the opinion that if the experience of teachers of night schools for mechanics and apprentices was more freely given, it would be of great assistance to others similarly engaged. Mr. Bushnell is heartily interested in the railroad night school at Cedar Rapids. His plan is to keep the students back in such things as drawing, until they get well along in arithmetic and studies essential to success in the study of mechanics. Middle-aged men, as well as young men, attend the school there. He says that where schools are established in connection with railroad shops, they have applications for work from young men who are desirous of having the privileges of the school, and reasons that such men are likely to make the best kind of workmen, and are a desirable acquisition to the shops.

The recent labor troubles have affected the building trades to a greater extent than any other prominent industry. Building in some of the large cities fell off half to three-quarters of its volume. As soon as labor matters become generally quiet, the building trades will probably resume their normal activity; but a good part of the season has been spoiled already. It may be that the workmen should not be held to account for this large check to the building business, but the facts are as above mentioned.

Literary Notes.

The Office is a new monthly periodical, the first number of which is dated June, 1886. It is devoted to the interests of business managers, bookkeepers and office men generally. It has a free advertising department for those who want situations or help. The contents of the first number are creditable articles and notes. Subscription is $1 a year. Publication office 205 Broadway, New York.

This is the way the *Tradesman*, of Chattanooga, talks business in a leading editorial:

If such a commercial and industrial newspaper organ as we are now making cannot command liberal support in subscription and advertising, then it will have been demonstrated that our manufacturers and commercialists are too stupid, too far behind the age to succeed in their lines, and must give way to better and more capable men, before the South will have a fair chance in the race of development.

We presume, after reading the above, the "manufacturers and commercialists" of the South will rush to support the *Tradesman*—or think about it.

From a late newspaper census, we gather the fact that of the 722 newspapers published in New York city, 309 are purely class papers and trade journals.

The bulky newspaper is losing public favor. People are more than ever disinclined to peruse ten to sixteen pages to gather comprehensive ideas or the morning news. General news enterprise and other things being equal the four page paper with matter condensed so as to be intelligible and quickly read will stand at the front despite the apparent favor that has heretofore welcomed the huge blanket sheets.

The *American Builder*, of Cleveland, is a very neat appearing weekly paper. Its subscription price is $2 a year if you pay for a whole year, but only 50 cts. for the remainder of this year.

The *American Millwright*, Vol. 1, No. 1, comes to us from West Middlesex, Pa. It is to be published monthly at $1.50 a year, and is the organ of the American Millwrights Association

Our foundry contributor, S. Bolland, has purchased an interest in the *Sewing Machine Journal*. Although not an experienced newspaper man, he will soon get to the core of the business, and do his part in moulding public opinion.

If anybody needs to be convinced that electricity is making substantial progress in the various arts that are made subject to the wants of mankind, let him peruse the pages of the *Electrical Review* every week. New uses for electricity are being developed and advances being made where it has long been in use. The *Electrical Review* is a weekly record of electrical progress.

No field is better covered by trade newspapers than that of milling. All of them appear to be well supported, but perhaps appearances are deceptive. Two of these have lately consolidated, and it would probably be good policy for some others to consolidate.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials, nor location will be published.

(250) I. X. L., Millview, Fla., asks: 1. Have the U. S. local inspectors of steamboats a printed list of questions which they ask applicants for license, and if so, how can I obtain a copy? *A.*—We do not know that they have such a list. If they do, it is manifestly for private use, and not to be made public. Making it public so that applicants had only to learn the answers to questions by heart, would entirely defeat the ends aimed at in an examination. 2. Where can I get a work on low-pressure walking-beam engines? *A.*—Write to any publisher of such works for a catalogue.

(251) G. W. V., Penryn, Cal., writes: 1. I have a vertical boiler with the tubes leaking badly at top end. I find them so crystalized or burned that I cannot calk or bead them, as they will break from a light blow of the hammer. Can I fix them by using thimbles, or are they burned down to the water line? *A.*—We presume the tubes to be bad down to the water line, and should advise new tubes from what you write. 2. I have a horizontal tubular boiler in which we are using muddy water. I have the fire banked when we shut down at noon, run the feed pump during noon hour, and about time we start up blow out 5′ or 6″ of water. Should I blow before breaking the fire, or should I wait till ebulition has raised mud from bottom of boiler? *A.*—If you use bottom blow-off, blow before you start the fire; surface blow is best used when steam is being made rapidly. 3. I want to put up a return tubular boiler, 44 inches diameter and 14 feet long, grate 4x4 feet. I expect to build bridge wall to within 7 inches of boiler, and 6 feet back of this I will build another wall. Should I fill up between the two, or should I leave a chamber, and if so, how deep, wood being used for fuel? *A.*—We should leave a chamber at least as deep as the grate is below shell. 4. Will an iron smoke-stack, 22 inches diameter and 40 feet high, give sufficient draft? *A.*—The diameter will do very well. Whether the height will be sufficient depends upon how hard you work the boiler. It will do considerable work with the height named, and more if the height is greater.

(252) B. H. D., New York, asks: 1. What is meant by a D-valve? *A.*—The ordinary slide-valve, in which the cavity usually bears a resemblance to the letter named. Locomotive slide-valves are usually D-valves. 2. At what temperature will water boil when confined? *A.*—It depends entirely upon the pressure. You will find this in steam tables in books on steam engineering, and in engineers' pocket-books. 3. Is twice the throw of the eccentric the full travel of a locomotive valve, or is it once the throw? *A.*—It is the more usual custom to call the throw of an eccentric the distance through which it will move the valve, if connected, without leverage.

(253) N. J. V., ——, ——, asks: What is the striking force of a stamp-head of the following dimensions: Diameter of cylinder, 15″; stroke, 20″; weight of head, 4,500 pounds; steam pressure, 90 pounds? *A.*—We do not know of any satisfactory expression for this. Nystrom's formula for steam hammer is:

$$F = \frac{(W + P)(S + s)}{s}$$

In this, F = the force, W = weight of ram in pounds, S = stroke of hammer in feet, s depth of penetration by the blow in feet, P = the total steam pressure acting on the piston (that is the area of piston multiplied by the pressure per square inch). You can use this formula for what you consider it worth.

(254) W. M., Memphis, Tenn., writes: We have a battery of three boilers, each 42 inches diameter and 21 feet long. We have recently had a steam drum put on, 36 inches diameter, connected by 10-inch necks. The boiler shells are ¼-inch, also the drum. The connecting necks are 5-16-inch. We have had some trouble with leakage of necks where the flanges are riveted to shell. It is claimed that this is caused by the large diameter of drum, which causes a heavy strain on the flanges. I claim that the size of drum has nothing to do with the strain to separate drum and boilers. 1. Which is right? You are. The direct pressure to separate the drum and boiler is only that due to the area of connecting necks multiplied into steam pressure. If, as we understand you, the drum is connected to the three boilers, it is probable that the leakage is caused by difference in expansion throwing a heavy strain on the necks. 2. We have braces running from the center of drum diagonally to shell. Are they of any use? *A.*—We doubt their being of much, if any, use.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Patent Att'y, H. W. T. Jenner, Washington, D. C.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

J. Clayton, Air Compressors, Rock Drills, 43 Dey st, NY

Edw. Sears, Wood Engraver, 169 William st., N.Y.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Tack, Wire and Shoe Nail Machinery. Wm. A. Sweetser, Brockton, Mass.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., NY

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

"Modern Steam Engines," $6; "Mechanical Drawing Self-Taught," $4 Joshua Rose, Box 3306, N. Y.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Foot-power Machinery, for workshop use, sent on trial if desired. W. F. & Jno. Barnes, Rockford, Ill.

Improved Labor-saving Upright Drills, 20-in. to 36-in., inclusive. Currier & Snyder, Worcester, Mass.

"How to Keep Boilers Clean." A book mailed free, by James E. Hotchkiss, 93 John st., N. Y.

Light mach'y of all kinds built at short notice. Edmund Mills, 8 Dey st., Jersey City Heights, N. J.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

Curtis Pressure Regulators, Curtis Return Trap Curtis Damper Regulator. See June 19, p. 12. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

"Morrison's Practical Engineer." A complete treatise (200 pp.) on steam and general mach. Mailed on receipt of $1. W. A. Morrison. Box 373, Lowell, Mass

Engine Lathes, Hand Lathes, and other fine tools, Assortment large; prices low. Frasse & Co., 62 Chatham st., N. Y.

Bound Volumes of the AMERICAN MACHINIST for the years 1880, 1881, 1882, 1883, 1884 and 1885. These volumes are strongly bound in cloth, and will wear well. Price $3.50 each; express charges additional. AM. MACHINIST PUB'G CO., 96 Fulton st., N. Y.

St. John Improved Self-adjusting Cylinder Packing, for marine and stationary engines and locomotives; applicable to water, air, oil and ammonia pumps. For durability and minimum of friction, it is unexcelled. Send for pamphlet. Address, Balance Valve and Piston Packing Co., room 58, 280 Broadway, New York.

Patent Binders for the AMERICAN MACHINIST, holding a complete volume (52 issues), simple, neat, durable. Price $1, prepaid, to any part of the United States by mail. To Canada or foreign countries the price will be 75c.; purchasers pay express charges and customs duties. AM. MACHINIST PUB'G CO., 96 Fulton st., N. Y.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price, $2, post-paid. Published by John Wiley & Sons, 15 Astor Place, New York.

MANUFACTURES

Zebulon Roles is erecting a wood-working machine shop at Raleigh, N. C.

D. H. and John Grimshaw, of Paterson, N. J., will erect silk mills at Reading, Pa.

The iron foundry to be erected at Spring City, Tenn., will be built by Burger & Varney.

S. H. Varney will erect a steam tannery at Spring City, Tenn.

The Piedmont Iron Works are building an iron foundry at Massie's Mills, Va.

The Spangler Manufacturing Company, York, Pa., is building an agricultural implement factory.

It is reported that the money to build a cotton compress at Anniston, Ala., has been subscribed.

R. M. Brooks, Jenkinsville, Ga., is negotiating for machinery for his new foundry and machine shop.

It is stated that a stock company is being formed at Dobson, N. C., to erect a foundry and manufacturing plant.

The machinery of the Ottawa Iron Works, at Ferrysburg, Mich., has been sold, and will be shipped to Chicago.

The Advance Threshing Machine Company, at Battle Creek, Mich., are working their men twelve hours a day.

The K. of L. have organized a baking powder manufacturing company at Elkhart, Ind. Capital, $25,000.

The contract for building the new shop for the Knowles Pump Works, Warren, Mass., has been awarded.

The Edison Electric Manufacturing Company, New York, has purchased a site for a building to cost over $100,000. A foundry will also be erected.

J. H. Philips, Canton, Ohio, and C. W. Wood, New Orleans, La., will erect a bolt and nut factory at Birmingham, Ala.

It is stated that the St. Louis, Arkansas and Texas Railway will spend $100,000 in erecting large machine shops near Pine Bluff, Ark.

The Hartford Hammer Co., of Hartford. Conn., is building a new shop, 104x50 feet. It will be ready for occupation about September 1.

E. J. Teller and others are organizing a stock company at Henderson, Texas, to erect a wagon and carriage factory.

The Atlantic Steam Engine works, Messrs. Arthur & Co., Brooklyn, N. Y., are running ten hours per day, and employ 60 men.

John A. DeRemer, of Schenectady, N. Y., has been appointed receiver of the McQueen Locomotive Works. The works are valued at $90,000, and will be sold.

The Columbian Iron Works, Wm. Taylor & Son, Brooklyn, N. Y., say that they have had no trouble with their workmen, and decline to speak further upon the subject.

The Excelsior Foundry and Machine Shop, Birmingham, Ala., E. R. Jones, president, has purchased a site, and will begin the erection of their buildings at once.

S. A. Smith, manufacturers' agent, 39 S. Canal street, Chicago, writes us: "Trade in machinery and tools has been very light, but dealers report last week as being quite an improvement.

The Old Colony Railroad has adopted the weekly payment system. The pay train has been discontinued, and local employes will be paid by the local agents of the company.

J. M. Henderson, A. C. Robeson, W. M. Nixon, J. J. Ivins and others are organizing a stock company at Athens, Tenn., to build a large woolen mill to cost about $60,000.

The site and property of the cotton seed oil mill of W. H. Stead & Co., Greenville, Mass., previously reported as burned, have been purchased by the American Oil Co., who will erect a new mill at once.

It is said that the Kilmer Manufacturing Co., of Schenectady, N. Y., have secured twenty acres of land at Newburgh, and will remove their works there. Immense buildings will be erected. About 1,500 persons will be employed.

The American Patent Steel Pulley and Wheel Company has been formed in St. Louis, with the object of manufacturing the Beldsmeyer patent steel pulley. A factory site has not yet been selected, but contracts for the building of the special machinery required are, it is said, being placed.

Merryweather & Sons, Greenwich Road, S. E. and 63 Long Acre, W. C., London, England, favor us with a copy of their new catalogue of hand fire engines, fire-escapes and firemens' equipments. It has 100 large pages, and illustrates a wide variety of apparatus, many of them novelties. The catalogue is a handy one for reference.

Samuel Thomas, of Catasauqua, Pa., writes thus to the Baltimore *Manufacturers' Record:* "We propose to build one furnace near Birmingham, Ala., at present, and lay out the work so as to build the second furnace at some future time. We propose to begin our operations in a consecutive way, and cut the garment according to the cloth. We shall begin with making pig iron now, and let the future decide as to other manufactures of iron. Our capital stock will be $1,000,000.

The Tubal Cain Iron works, John Robertson & Co., Brooklyn, N. Y., are running ten hours per day, except Saturday, when the works close at 3 P. M. Several years since, during an eight-hour agitation, the works closed at 12 o'clock Saturday, giving the men a full week's pay. About two years since the time of closing was fixed at 3 o'clock on Saturday, with full week's pay, and has since remained so. There has been no trouble or strike at these works.

An independent oil refinery is about to be started at Washington, Pa., by the independent oil producers of the Washington district. The company to erect the refinery will have a capital of $400,000, and the plan contemplates a pipe line through the the field, as well as the erection of a refinery with a capacity of 500 barrels daily. In the company are James G. Blaine and Stephen B. Elkins. The Washington oil, it is claimed, will yield 65 per cent. of 110 deg. oil, which is much above the average.—*Oil, Paint and Drug Reporter.*

The Missouri Malleable Iron Co., of St. Louis, have the bids all in and the contract probably let for the addition to their foundry. The new structure will be 200 feet long by 70 wide. This occupancy of additional space will necessitate the putting in of another cupola for gray iron, the building of a second air furnace for malleable castings, and the making of provision for a new core room, tramway, sheds, etc. Building operations will be begun at once and pushed vigorously. —*Age of Steel.*

At the Worthington Pump Works, Brooklyn, N.Y., about 300 men are now at work. About the time the labor agitation commenced an increase of about ten per cent. in wages had just been granted the men. A request being made for nine hours, it was agreed to give it to them, provided they would sacrifice the recent advance and not strike. As another compromise, ten hours' time was offered the men, with ten and a-half hour's pay, but this was also refused, and 250 of the 500 men went out on strike. At present the works are running ten hours per day, and about 300 men are at work, new men being taken on every day. About 400 men only will be employed during the coming summer, or as long as present prospects continue.

The Pioneer Iron Works, Brooklyn, N. Y., are very busy with their Cuban trade in sugar machinery. About 130 men struck for 53 hours per week, and remained out two weeks, when the demand was conceded. They also receive an advance of about ten per cent. on the ten-hour pay. On Saturdays the works run only seven hours, to make up the time lost. The men work nine hours on Monday, Tuesday and Wednesday, and nine and a-half hours each on Thursday and Friday. It is stated that no new orders are being taken, and that after present contracts are filled things will receive a thorough reconstruction. It is also stated that prospects for next winter are decidedly unfavorable.

The Billings and Spencer Co., Hartford, Conn., have issued a new and very complete 86-page circular, illustrating and describing the specialties they manufacture. The illustrations of drop forgings are excellent examples of work in that line, and convey the idea that almost anything can be made in this way. The illustration of machine wrenches is very complete, and will of itself give valuable information. In finished small tools for machinists the circular shows a good variety. Any one in the machine business will find this circular a handy thing to have. The price-list is very complete, and if carefully studied will show that many standard articles of every-day use can be bought much cheaper than made. The illustrations are excellent and the printing first-class.

At the Atlas Iron Works (Foundry Department of the E. W. Bliss Company, Brooklyn, N. Y.), a demand that the pay of laborers be advanced ten per cent was made to the company and granted by them, whereupon a further demand was made for a ten per cent. advance on the pay of every man employed in the works. This demand being granted, the men struck and remained out four weeks, after which, mutual concessions being made, about 25 men resumed work. The demands of all the workmen were presented to the company in writing, and each man's request individually considered. At the time of the strike 50 men were at work, with the prospect of employment all summer. When the works started June 1st, 25 men were sufficient to do all necessary work. Ten hours constitute a day's work.

At the Lidgerwood Mfg. Co., Brooklyn, N, Y., the wages were raised about ten per cent., and a demand made for nine hours to constitute a day's work. It was suggested that nine hours be called a day's work under the old wages. This proposition was accepted until the pattern-makers demanded nine hours, together with the ten per cent. advance. This being refused, the pattern-makers staid out about two weeks, when, some urgent work having to be done, the pattern-makers' demands were conceded, and they were employed at their own terms until the work was completed, then they were discharged. It is stated that the nine-hour day causes a loss of $1,250 per month, and necessitates employing twelve to fifteen extra men all night. July 1st these works will be closed and stock account taken. When the works re-open they will be run nine and ten hours to accommodate those who wish to work either length of time, but pay will be given for the number of hours worked.

The Puritan Iron Foundry, James Mitchel, proprietor, Brooklyn, N. Y., received a demand from the Foundry Workers' Union and New York Protective Association that the wages of all his employes be increased by amounts ranging from ten per cent. upwards, according to the pay received by each workman. A man who received $2.75 or $3 per day should receive a small advance, the $2 men a larger advance, and the $1.50 men a still larger advance. A compromise was eventually agreed upon, and no strike took place at this foundry. As an effect of the movement it is noted that the low-priced men (who received the largest advance) are being quietly weeded out, and, when business will warrant, their places will be filled with a higher grade of workmen. During the past winter this foundry run upon stock much of the time, at a decided loss, in order to keep the men together and employed. It is further stated by Mr. Mitchel that, should a like dull season occur the coming winter, the foundry will be promptly closed.

The South Brooklyn Boiler Works, Daniel McNeil, Brooklyn, N. Y., are making extensive repairs to the steamship Europa. The vessel went ashore last winter, and eighty of her plates must be replaced by new ones. Other extensive repairs are necessary about the vessel, which will bring the cost of the job to about $40,000, and at present keeps about 150 men at work ten hours per day for ten hours' pay. Twenty men are employed in the shop, and also work ten hours. Some novel boilers are being built for one of the heaviest dredges belonging to the Atlantic Dredging Co. Each boiler consists of two 8-ft. shells, connected by two 20″ tubes, which form a combustion chamber. The fire-box is inside the first 8-ft. shell, and is made of three sheets, longitudinal seams welded, and joints corrugated to remove rivets from contact with the fire, also to correct collapsing tendencies in the fire flues. The drums of both boilers are connected by a 20″ flue, similar to those between the 8-ft. shells. A lot of steel work ⅜″ thick is being made at these works for Marx & Rawolle's Glue and Glycerine Works, Brooklyn. This work includes flues for conveying hot air from furnaces to vacuum and boiling pans; also to warm a boiler in upper part of the factory. No trouble has occurred in relation to the short day movement, and everything is reported satisfactory.

Machinists' Supplies and Iron.

NEW YORK, June 10, 1886.

The outlook remains about the same as last week. The recent decline in copper and advance in tin has caused a flutter in the market.

Iron—In American pig there has been no change worth recording. We quote Standard Lehigh and North River brands $18 to $18.50 for No. 1 X; $17 to $17.50 for No. 2; and $16 to $16.50 for Forge.

Scotch Pig—A very light demand for Scotch Pig has been met from store. We quote Coltness, $20; Glengarnock, $19; Gartsherrie, $19.50; Summerlee, $19.50; Eglinton $17.50 to $18; Langloan, $19.50, and Dalmellington, $18.50.

Tin—The market shows a decided upward tendency. Banca, 22¾c.; Straits and Mallaca, 22.35 c.

WANTED

"Situation and Help" Advertisements, 30 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Draftsman, experienced in shop and office, with thorough technical education, desires situation. Address X. X., AM. MACHINIST.

Mech. engineer and draftsman, competent practically and theoretically, desires engagement in works or drafting room. Address W. S., 9 Bickerdike st., Chicago, Ill.

Wanted—First-class practical mechanic and manager wishes to correspond with parties in need of a foreman or supt. of machine works; first-class references given. Address Box 13, AM. MACHINIST.

Wanted—Situation by a first-class pattern-maker and draftsman; 26 years' experience in engines and general machinery; 12 years as foreman and manager; age, 40; married; good references. Address Patterns AM. MACHINIST.

A first-class mechanical engineer and draftsman, with large experience in printing machinery, here and abroad, desires engagement as superintendent of works, or as head draftsman. Address S. M. H., AM. MACHINIST.

A technically educated man, having practical experience in shop, office and drawing room, desires a situation where theoretical and practical knowledge will be of use; highest recommendations. Address T. Williams, AM. MACHINIST.

Wanted—A first-class man having from $5,000 to $10,000, to take position of assistant superintendent of large foundry and machine shop in a city of 200,000 inhabitants; must have satisfactory references as to business and mechanical ability. Address A. B. Bowman, 823 N. Second st., St. Louis, Mo.

Wanted—Foundry foreman wants position; is 35 years of age, and has had 11 years' experience as superintendent of foundries on large variety of work and management of men; can give first-class reference, and good reasons for wishing to leave present position. Address, "Energetic," AM. MACHINIST.

Wanted—A practical man as foreman of machine shop; one with strictly temperate habits, industrious, accustomed to handling men, and experienced on automatic and plain engines, blast furnace, architectural and iron house work, locomotive and general repairs; none other need apply. Address, stating experience, reference and salary expected, "Manufacturer," AM. MACHINIST.

Wanted—Foreman for printers' machine shop; a man capable to superintend repairs of all kinds on presses, cutters, etc.; also general jobbing and constructing; one with some cash can have interest; business has been established several years; has good run of trade; modern tools in shop, and experienced men only employed; references required. Address "Printers' Machinist," AM. MACHINIST.

✣ MISCELLANEOUS WANTS ✣

Advertisements will be inserted under this head at 35 cents per line, each insertion.

The Cyclone Steam Flue Cleaner has no equal. Crescent Mfg. Co., Cleveland, Ohio.

Steel stamps, stencils, burning brands, and brass checks. T. M. Parker, Hartford, Conn.

Tabor indicators; one pair in box, with full set of springs; all in good order; $100 cash, or separate at $50. Address B., Box 99, AM. MACHINIST.

To rent, with machinery, tools and fixtures, new brick shop, with water front, near New York; fine location for doing marine engine work. Address Box 15, AM. MACHINIST.

Send for estimates of high-speed compound engines for stationary and marine service. Crist Engine Works, 140 Baxter treet, N. Y.

Useful information steam users and engineers 100 page book on care, etc., of boilers. Send 25 cents in stamps. J. N. Mills Pub. Co., 30 Vesey st., N. Y.

Special tools and machines for mfg. designed and built to order; mechanical and Patent Office drawings. Weston & Smith, Syracuse, N. Y.

Wanted—Estimates for fifty (50) steel straight-edges 6′×2″×¼″. For particulars address E. O. Randall & Co., 93 N. High st., Columbus, Ohio.

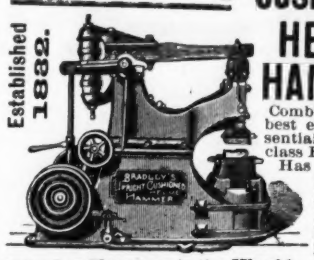
M. Martin, manufacturer, P. O. Box 285, New Brunswick, N. J., will contractfor the manufacture of articles in brass and other metals (stamped or turned), and dies and tools for making same; also patent novelties, electrical inventions, special machinery castings, etc.; estimates cheerfully given.

For Sale—A well established foundry and machine shop, including lots, buildings, machinery, patterns, and stock on hand, situated in Logan, Hocking Co., Ohio; will sell on easy and satisfactory terms; reason for selling—old age and ill health. Apply to R. Belt, Logan, Ohio.

For Sale—Machine, foundry and forging shops in the great lumber district of Central Penn. The only shop within 100 miles square; present proprietor 25 years in machine business; shop and tools new within 3 years; will sell a whole or a ¾ interest; capital required for the whole, about $10,000; the purchaser of a ¾ interest must be a theoretical and practical mechanic. Address C. P. Colver, Emporium, Pa.

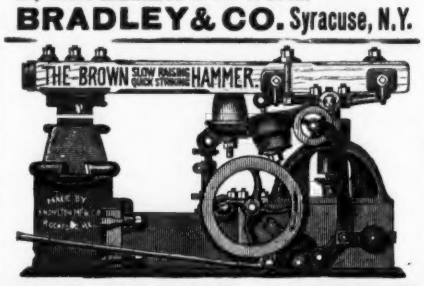
BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER

Established 1882.



Combines all the best elements essential in a first-class Hammer. Has more good points, does more and better work and costs less for repairs than any other **Hammer** in the **World.**

BRADLEY & CO. Syracuse, N.Y.



THE BROWN HAMMER
STRIKES A BLOW WITH
DOUBLE THE VELOCITY That it Raises The Hammer.
A NEW MOVEMENT! SEND FOR DESCRIPTION.
KNOWLTON MFG. CO., King St., Rockford, Ill.

BEAUDRY'S UPRIGHT CUSHIONED POWER HAMMER

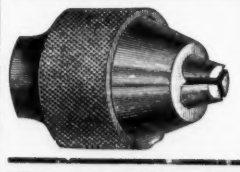
The success of our Machine is the best guarantee of its value. Only Machine with Double Helve. Does more and better work with less repairs than any other.

BEAUDRY & CUNNINGHAM, Boston, Mass.

FITZGERALD'S BOSTON MACHINIST. 18mo, cloth.	$ .75
CHORDAL'S LETTERS TO MECHANICS, &c. 12mo.	2.00
THURSTON'S MATERIALS OF CONSTRUCTION. 8vo.	5.00
THURSTON'S FRICTION, IN MACHINERY, &c. 8vo.	3.00
WEST'S FOUNDRY PRACTICE. 12mo, plates.	2.50
WEST MOULDER'S TEXT-BOOK. 12mo, plates.	2.50
MCCORD'S PRACTICAL MECHANISM 8vo.	5.00
WRINKLES AND RECIPES FOR MECHANICS AND ENGINEERS	2.00
GRIMSHAW'S ART OF SAW FILING. 18mo, plates.	1.00
HOLLY'S " " " 18mo, plates.	.75
BALDWIN'S STEAM HEATING FOR BUILDINGS.	2.50
CROMWELL'S TOOTHED GEARING, &c. 12mo.	2.00
CROMWELL'S BELTS AND PULLEYS. 12mo.	2.00
SINCLAIRS' LOCOMOTIVE ENGINE RUNNING, &c. 12mo	2.00
THURSTON'S STATIONARY STEAM ENGINES. 12mo.	1.50
GRIMSHAW'S STEAM ENGINE CATECHISM.	1.00

Published and for Sale by

JOHN WILEY & SONS, 15 Astor Place, N.Y.



Almond Drill Chuck
Sold at all Machinists' Supply Stores,
T. R. ALMOND,
83 & 85 Washington St., Brooklyn, N. Y.

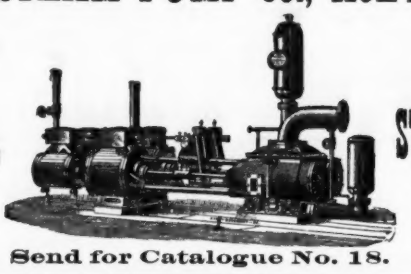
STEPHENS PATENT VISES.

50 Per Cent of time and labor saved by using this solid, strong, durable, quick-working Vise. Has the improved taper pipe, and other attachments. Sold by the trade. Send for circular.
MELVIN STEPHENS, Prop'r.
Office, 41 Dey St., New York.

IF YOU ONLY KNEW HOW GOOD THE
ELLIOTT CUTTING OFF TOOL IS,
You would not sleep until you had ordered one.
STERLING ELLIOTT, NEWTON, MASS.

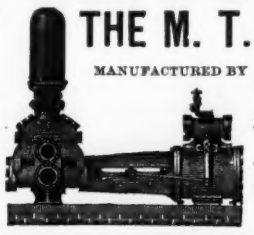
THE DEANE STEAM PUMP CO., HOLYOKE, MASS.

BUILD WATER WORKS, ENGINES AND STEAM PUMPING MACHINERY.



Send for Catalogue No. 18.

THE M. T. DAVIDSON IMPROVED STEAM PUMP



MANUFACTURED BY **DAVIDSON STEAM PUMP COMPANY.**
WARRANTED THE **BEST PUMP** MADE FOR ALL SITUATIONS.
PRINCIPAL OFFICE, No. 77 LIBERTY STREET, N. Y.
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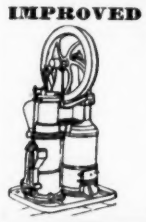
IMPROVED **RIDER HOT AIR PUMPING ENGINE**



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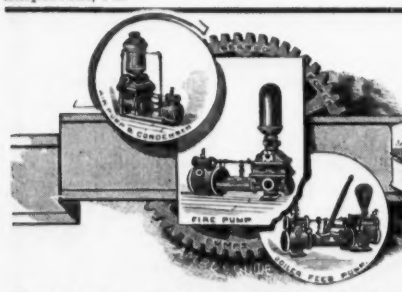

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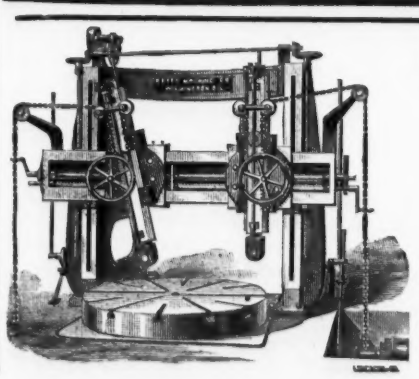

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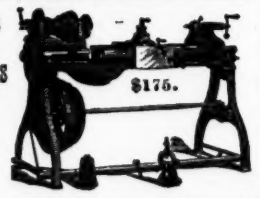

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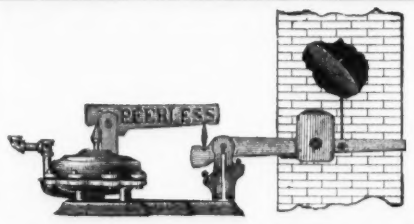

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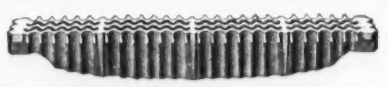

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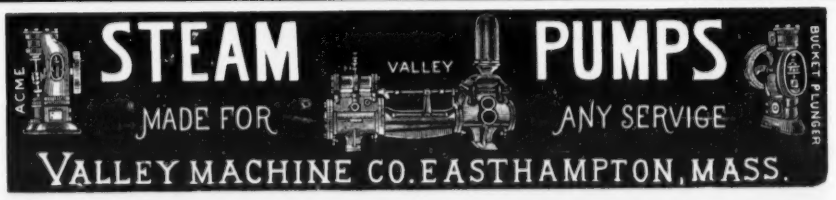

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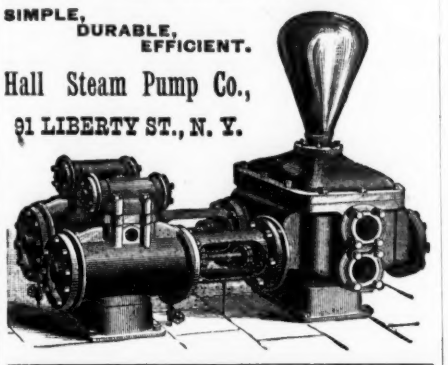

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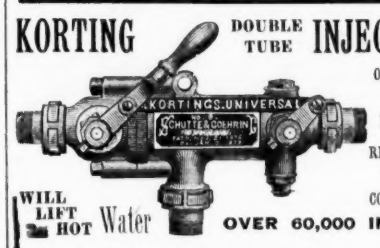

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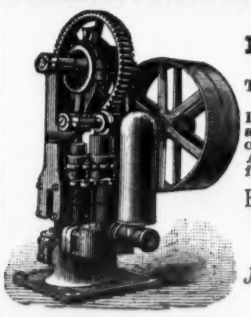

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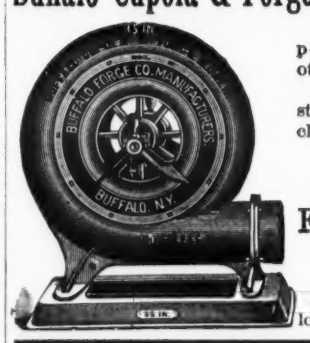

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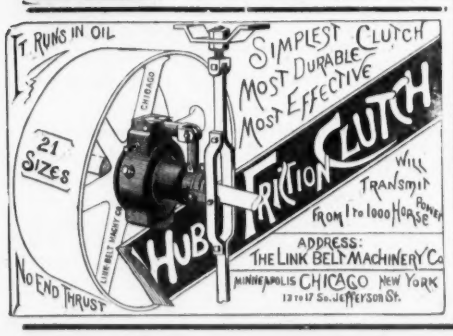

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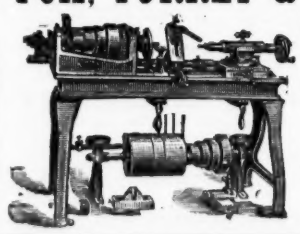
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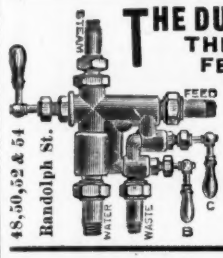

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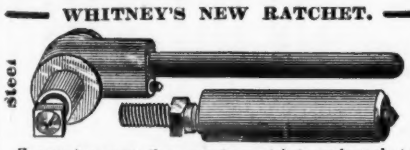

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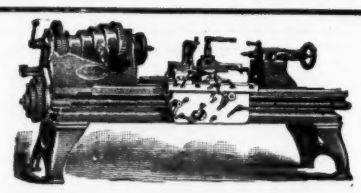
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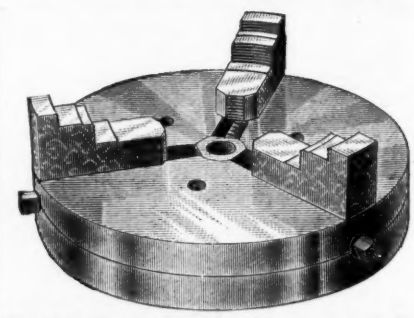
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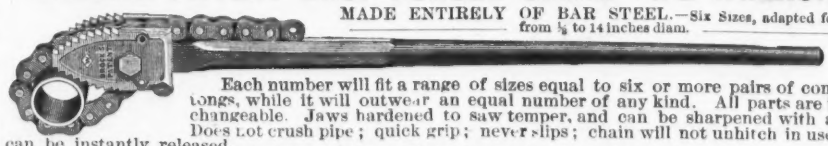
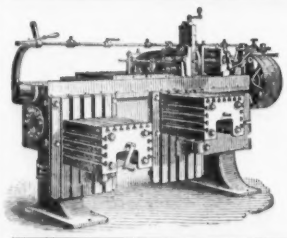

Each number will fit a range of sizes equal to six or more pairs of common tongs, while it will outwear an equal number of any kind. All parts are interchangeable. Jaws hardened to saw temper, and can be sharpened with a file. Does not crush pipe; quick grip; never slips; chain will not unhitch in use, but can be instantly released. J. H. WILLIAMS & CO., Iron & Steel Drop Forgings, 11 Richards St., near Hamilton Ferry, Brooklyn, N. Y.


Philadelphia, June 2d, 1886.
E. A. Walker, 75 Laurel St., Philadelphia, Pa.
Having used the "RICHARDS PATENT COMBINATION PLANER AND SHAPER" almost daily, for several months past, I take pleasure in testifying to its merits. I find it an exceedingly useful and desirable addition to the machine shop, easily manipulated, well balanced in all its parts, and accurately constructed; in short, it fulfills all the inventor claims for it, and fully comes up to what I had expected of it from its previous recommendations.
HARRY CAIN, Engineer,
At Powers & Weightman's Laboratory,
Falls Schuylkill, Phila.

Patent Flexible Back Hack Saw for Machinists' Use

Made of best Band Steel. The teeth only are hardened by an entirely new process, the back remaining soft and flexible. Warranted not to break. Send for sample and circular. Endorsed by The Pratt & Whitney Co., John Henney, Jr., Supt. Motive Power, N.Y. & N.H. & H. R. R. and others.
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Manufacturers of Morse Patent Straight-Lip Increase Twist Drills.

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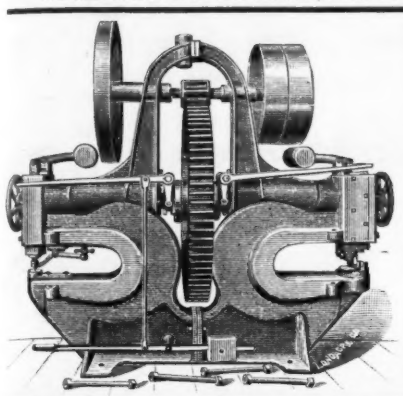

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Improved Horizontal Punches.
A FULL LINE OF
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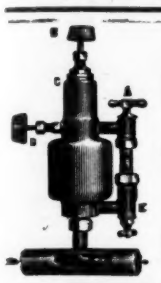

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Manufactured by
The Craig Sight Feed Lubricating Co.
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Manufacturers of
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DROP FORGINGS OF IRON OR STEEL
BEECHER & PECK, NEW HAVEN CONN.
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For Reducing and Pointing Wire.
Especially adapted to pointing wire rods and wire for drawing.
For Machines or information, address the manufacturer.
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MADE BY
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SIZES TO SUIT STEAM PLANTS, UP TO 300 H. P.
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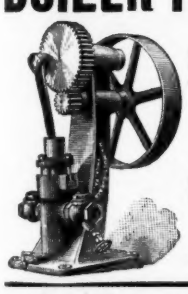

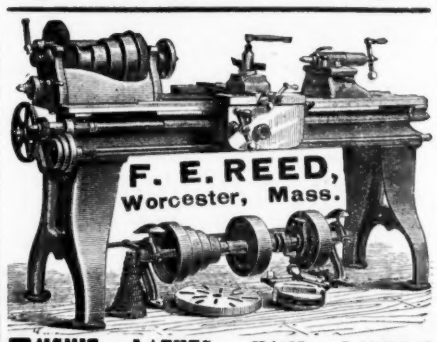

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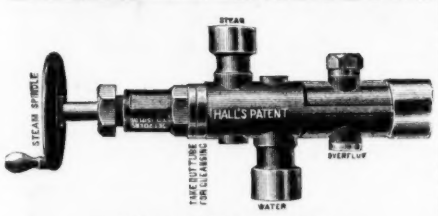

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Manufacturer of
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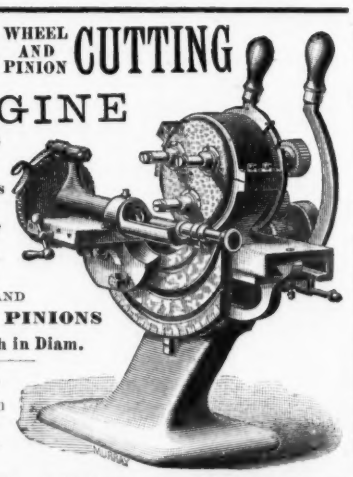
SEND FOR FULL LIST

No. 5 WHEEL AND PINION CUTTING ENGINE
Will Cut Brass Wheels to 5 Inches in Diameter, Spur, Bevel or Crown; AND STEEL PINIONS To 1 Inch in Diam.
Send for Description and Prices.



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All rubber. Indestructible. Throws solid stream. Mist or spray produced, closely concentrated or widely diffused, by compressing soft rubber tip. Requires no packing. Best for gardens, carriage washing, factories, etc. By mail postpaid 1-2 and 3-4 in. 50 cts, 1 in. 75 cts., 1 1-4 in. $1. Trade supplied.
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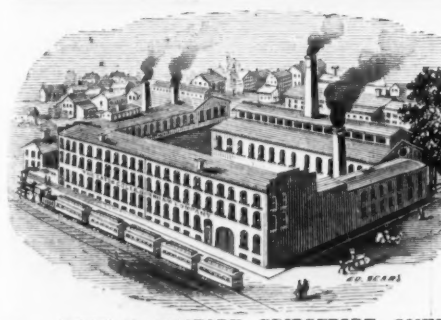

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Manufacturers of
PIPE CUTTING and THREADING MACHINES,
Operated by Hand or Power.
FITTINGS,
VALVES, PIPE, PIPE TOOLS,
and all styles of
Iron and Brass Goods
For STEAM, WATER and GAS.
VIEW OF FACTORY, BRIDGEPORT, CONN.

A Few Letters.

AFTER THE STYLE OF "CHORDAL"—A LONG WAYS AFTER!

Since our advertisement in May 29th issue of this paper, entitled "Some Information," we have received hundreds of letters asking for catalogues, but there are thousands of others who read this in whose hands our catalogue should be, and whom we would like to have as customers.

The following letter may explain the feeling of some in regard to this matter:

OHIO, May —, 1886.

Gents: * * * What is the use of your advertising, inviting people to send you 10 cents for price list? If you have anything to sell, why don't you send a catalogue in the first place?

Resp'y yours, * * *

Our reply to him was, in substance, as follows: *Sir*—Yours at hand, and we must confess that it was somewhat of a surprise to us, as we have never had anything of the kind before. Among our reasons for not doing as you suggest are * * *

The catalogues cost us a great deal of both time and money to compile and print, and are not pamphlets or "dodgers," but bound books, and we are sure that the general information contained in them will amply repay any one to the extent of the cost of mailing them.

We are selling staple articles (not patent medicines), and our margins of profit are not large enough to allow us to distribute the catalogues like almanacs, or to send them to every boy or "catalogue fiend" who can "scare up" a cent to buy a postal card to order a catalogue with.

It has been our experience (and we have tried both ways thoroughly) that those who are not interested enough to pay mailing expenses on a first-class catalogue are not interested sufficiently in the fine line of goods shown in catalogues to buy them. * * *

We are selling tools and not catalogues. We print below a few letters received by us, which sing a different tune.

From G. S. THOMPSON, City P. O., N. Y.

"* * * Your new catalogue is magnificently unabridged, and is somewhat ahead of anything I have, and I have pretty nearly all of them. I will show it to 'everybody,' and will in a short time mail you an order."

From O. WARREN, Marshall, Minn.

"Your Metal Workers' Catalogue came to hand, and taken in connection with Wood Workers' Tool Catalogue, received a short time ago, they are the most complete I have ever seen."

From F. C. BUTTS, Springfield, Dak.

"Your catalogue received all right, and I must say that it is the finest and most complete that I have ever seen in that line and should be in the hands of every mechanic, working either in wood or iron, in the land. Accept my thanks."

From C. H. MORGAN, with J. T. Noye Mfg. Co., Buffalo, N. Y.

"* * * Has a decidedly neat appearance, and will fill the wishes of machinists for a handsome, complete and reliable work, perfectly arranged for quick and ready reference, and no doubt will give you a decided trade advantage which you richly merit."

Catalogue No. 2.—Tools and supplies for machinists, engineers, molders, manufacturers, and all users of metal working tools; 264 pages, over 1,000 illustrations; sent free on receipt of 10 cents in stamps.

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MANUFACTURERS OF THE ORIGINAL
TRADE **I. X. L.** MARK.
Pipe Cutting and Threading Machine.
BEWARE OF IMITATIONS.
None genuine without our Trade-mark and Name.
STEAM AND GAS-FITTERS' HAND TOOLS.
Pipe Cutting and Threading Machines, for Pipe Mill Use, a Specialty.
Send for Circulars. YONKERS, N. Y.

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Cut Theoretically Correct.
For particulars and estimates apply to
BREHMER BROS.,
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DROP FORGING
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THE
Slate Sensitive Drill
Adapted to rapid work with small drills. Its extreme sensitiveness prevents clogging and breakage of drills. Has a swinging table with attachment for center drilling. Instantly adjustable to different lengths of work. Over 200 already in use. Send for Circular.
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FAY & SCOTT, DEXTER, ME.
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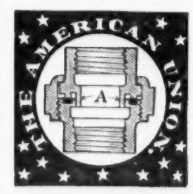
It will "Pay the Piper,"



If he aims to pipe well for STEAM, WATER, GAS, ACIDS, OILS, AMMONIA, &c., to examine this UNION, which requires no packing, but is always ready for instant use. When you next order Fittings of any Dealer, ask for a sample American Union to come with them, and it will tell you the whole story, or we will, if you write us for particulars.

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Radial Drills, Multiple Drills,
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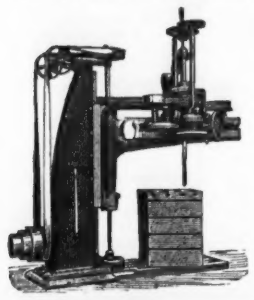

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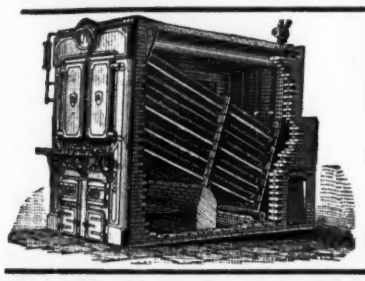

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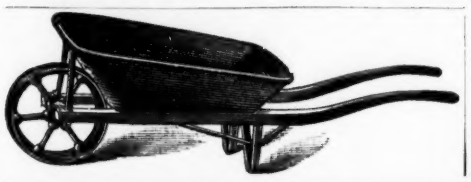

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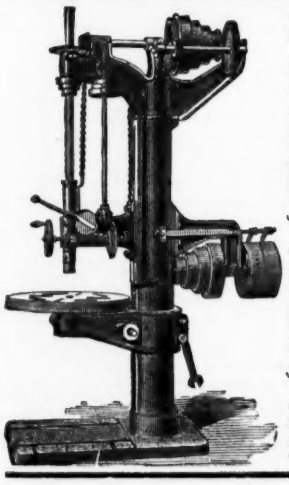

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The Highest Results Obtained from Exhaust Steam.

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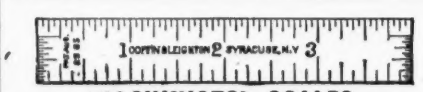

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perfectly, gain power and save oil by using our Patent Automatic Sight Feed Lubricators, showing oil as it enters, drop by drop.

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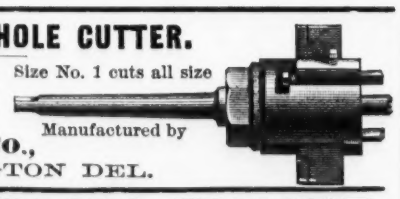

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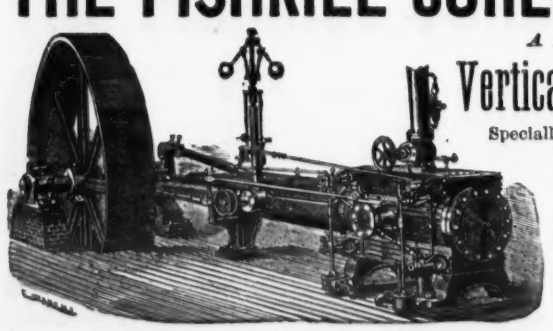

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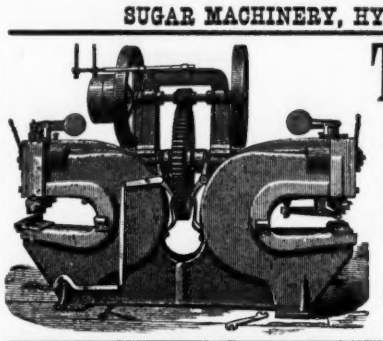

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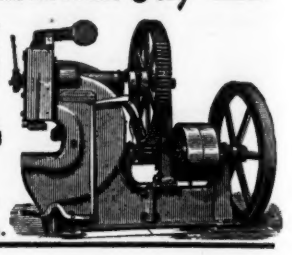

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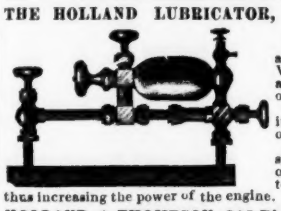

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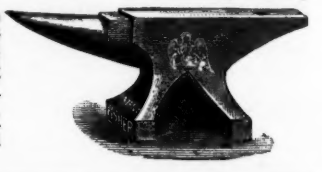

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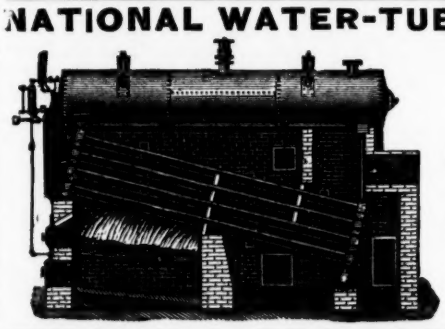

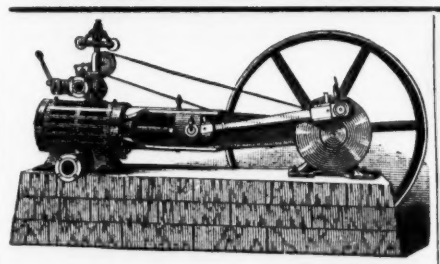

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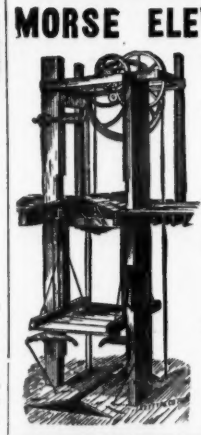

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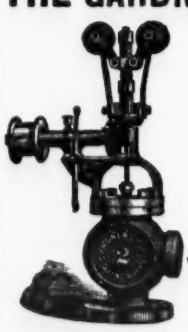

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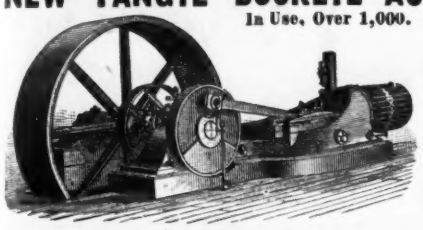

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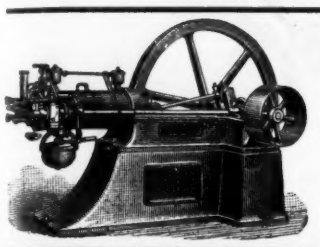

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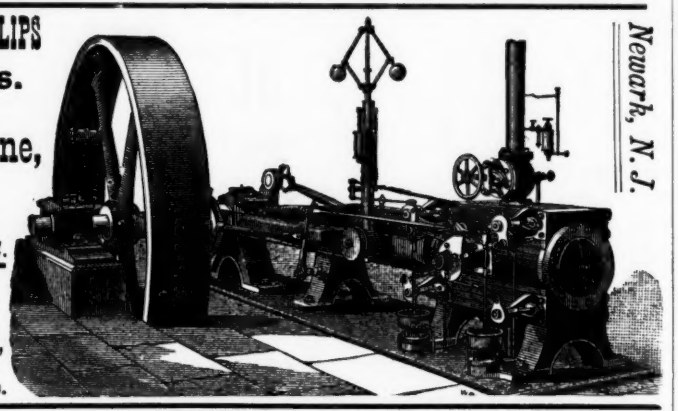

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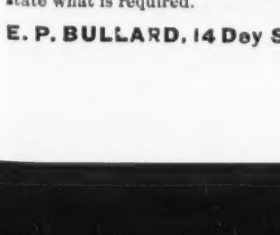

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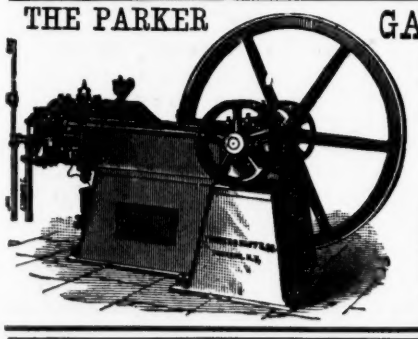

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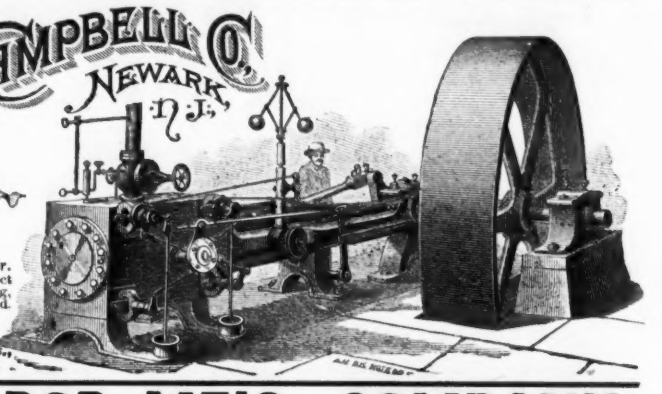

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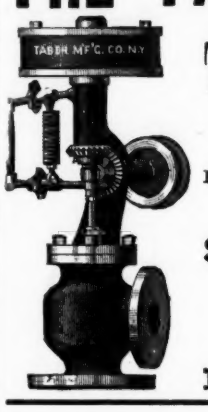

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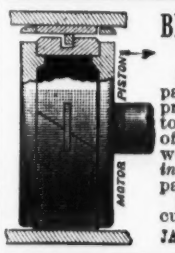

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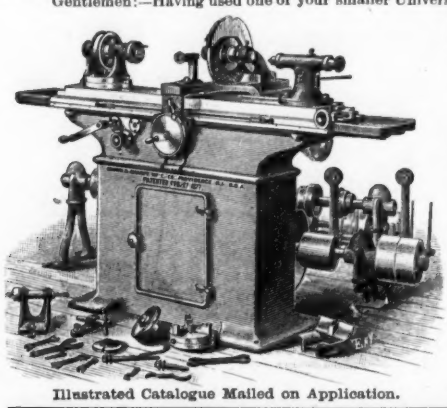

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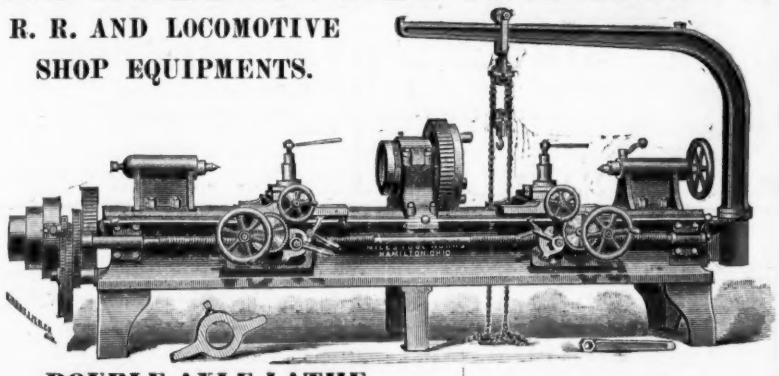

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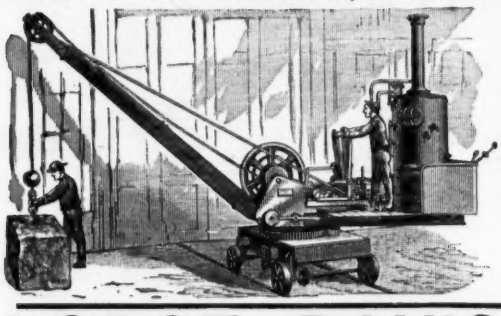

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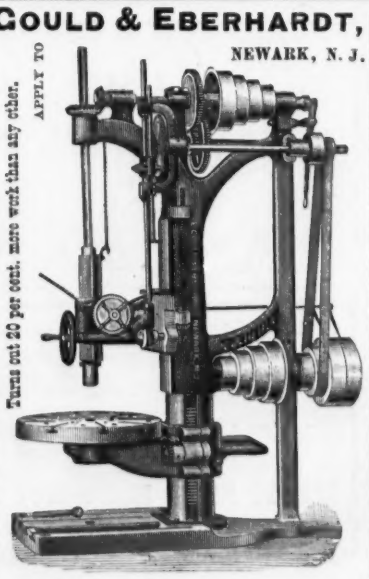

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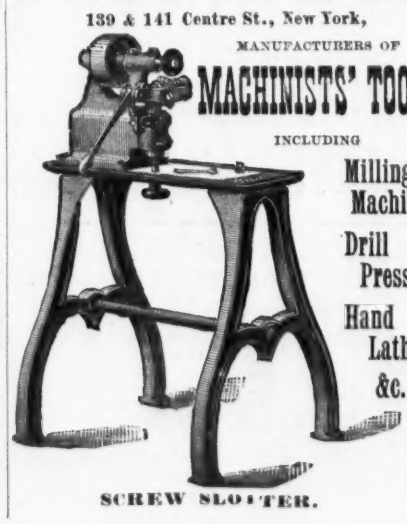

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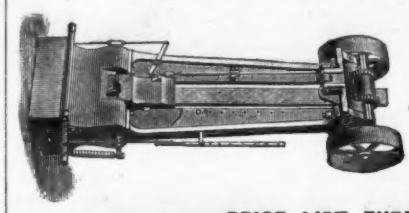

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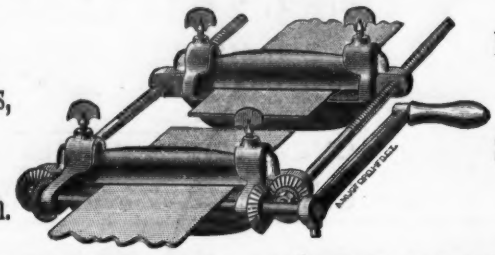

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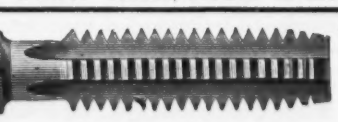

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